FACTORY MANAGEMENT AND CONTROL

MACHINERY'S
YELLOW BACK
— SERIES —

No. 21

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John. Leslie
Freeman.

FACTORY MANAGEMENT AND CONTROL

STARTING AND ORGANIZING A NEW FACTORY—
CONTROL OF PRODUCTION AND COSTS

BY J. H. LOWER, A.F.R.Ae.S.

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PREFACE

This book has been written as a guide for those concerned with efficient factory organisation and as a text-book for the student who aims at reaching an executive position.

During recent years we have seen a great expansion in industry, and the author is convinced that future training of technicians for executive positions must be developed along lines similar to those for recognised engineering and scientific degrees.

Executives often realize that their particular factory organisations could be much improved if only they could have a clean start, but in old established concerns with traditional procedures in operation it is often exceedingly difficult to institute modern systems of control. This is fully appreciated, but it is hoped that this book will be of assistance to those confronted with the task of management and production, whether with entirely new ventures, or already established concerns.

The opening-up of a new factory, although calling for hard work and clear thinking, is, to the efficient executive, an easier job than re-organising a factory of long standing. To those charged with the latter responsibility the author would give a warning :—

> " . . . . . .Plain common sense demands that, when we make reforms, we shall take care to preserve all such constituents of the existing order as are valuable. Nor is this all. Change, as such, is to most human beings more or less acutely distressing. This being so, we shall do well to preserve even those elements of the existing order which are neither particularly harmful nor particularly valuable, but merely neutral. . . . . " (" Ends and Means "—by Aldous Huxley.)

Management to-day calls for certain qualities of leadership widely differing from those of yesterday. It is not suggested that older executives with wide experience should automatically be termed inefficient, but it is essential that those in control in the future should not only command respect as persons, but possess such technical qualifications as will enable them to control all phases of their organisations. Practical experience in the manufacture of the particular product is, of course, necessary, while, in addition, a sound mathematical training is desirable.

It is not enough that a manager should be able to choose the right type of staff, he should be able to organise the various departments himself if need be, and know sufficient about the matters to be handled by them, to judge competently the work of his subordinates. On the other hand he must not be so occupied with detail that he cannot afford the time for giving thought to matters of higher policy and for looking into the future.

In this country we lack facilities for good training in management and factory control, either for the young who aspire to higher positions, or for older executives who would benefit from " refresher courses ", and this book may serve a useful purpose in opening-up channels of thought in the minds of its readers.

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CHAPTER 1

STARTING A NEW FACTORY

The manager need not be an expert in architectural design or structural engineering; experts will be engaged for this work. Nevertheless it is important that he should be able to link his requirements closely with the architect's views, and make correct decisions having regard to all the circumstances.

The Site

If it is possible to choose from more than one site, the following points should be borne in mind when deciding on the location of the factory.

1. Will the incoming raw materials and outgoing finished products require the use of road, rail, or water transport, and what are the facilities available, or adaptable ?

2. What excavating and clearance of the site is necessary ? When this is done will normal foundations suffice or is the subsoil of such a nature as to require extensive piling, etc.?

3. What electricity, gas and water services will be required ? With regard to the latter it must be remembered that fire hydrants will be necessary together with adequate water pressure.

4. In addition to the factory itself and probably administrative offices, what space is available for internal roads and yards, scrap bins, maintenance workshops, etc.?

5. Will separate buildings be required for boiler plants, electricity substations, special treatment processes, etc.?

6. Will any employees be using motor cars or bicycles and what facilities for parking them will be required ?

7. Is the proposed district within easy reach of suitable housing estates for the employees, or is suitable ground available in the vicinity, for such estates if necessary ?

8. If a large number of employees may be living at a considerable distance from the factory it will be necessary to provide canteen facilities in a suitable building.

In addition it is undesirable that employees should, during meal time breaks, wander aimlessly in and about the factory buildings. Therefore if a portion of the site can be allocated for recreation purposes. this will be a worth while amenity.

9. If, at a later date, it should be found desirable to enlarge the factory, will this be possible ? In this connection it is often inconvenient if a factory building can only be extended in one direction, as the internal layout of the factory for the various production processes may be handicapped in consequence.

The factory site should be chosen with care, not only from the considerations mentioned above, some at least of which vitally affect the initial capital outlay, but also with an eye to the external appearance of the factory as a whole.

The planning of housing estates, etc. for the future is receiving national attention to a marked extent, and many interested parties expound the theory that factories should be kept well away from towns. This may or may not be desirable, but if as much attention were given to the pleasing external appearance of factory premises as is generally afforded to private residences, picture palaces, theatres and the like, there would be no objection to workers being housed in close proximity to their work.

The old drab buildings for factories should be a thing of the past, and every effort should in the first place be made to develop establishments of pleasing appearance, both externally and internally. Every possible means should be invoked to ensure that both executives and workers feel as proud of their works as they would of their own homes. After all, those employed, whether at the bench or lathe, or in the office, must spend the major portion of their waking hours at the factory, and it must not be assumed that the correct type of essential amenities necessarily involves additional expenditure if due thought and planning are exercised.

The Factory Buildings

As mentioned previously, the appearance of the factory buildings is of some consequence. The main problems confronting the executive charged with the responsibility of the development of the factory, however, are those connected with his requirements for achieving the production demanded, with the amount of capital allowed. Here, of course, the architect plays an all-important role. So many factors are involved that it is impossible to enumerate them all, and somewhat difficult to place them in anything like correct priority.

The main productive unit or building must be carefully considered from the following aspects :—

(*a*) *Floor space available and shape.*

The maximum possible floor space must be obtained for production purposes, and yet due regard must be paid to the proposed routing of the work. Where will the raw materials be stored ? Through what processes will these materials pass ? Are the details first made, then joined in groups to form sub-assemblies, the sub-assemblies into major assemblies and components, etc.? From which part of the factory will the final products emerge ?

These and scores of similar questions must be asked and answered, re-asked and so on. Plans will be drawn and scrapped. Conference after conference will take place with this person and that person, to obtain opinions from all possible angles. The first decision will not be easy.

It is fairly safe to say that the building will ultimately be of some rectangular form, but even the proportions finally adopted may be a compromise, after considering the span of bays and roof trusses which the architect suggests.

(*b*) *Height.*

A variety of considerations enter into the decision here. A governing factor will probably be the clearance required from floor level for manufacturing purposes. If an overhead travelling hoist is to be used, advice will be necessary once the lifting capacity has been determined, so that the additional height required for the traveller can be obtained.

The depth of roof truss relative to span may again cause reconsideration of the length and breadth of the building, and so on.

Two important items are the heating and lighting of the factory. The height governs the volume to be heated, and, particularly in the case where a travelling hoist is to be installed, the distance of electric lights from bench level. The latter affects the wattage required for a given candle power illumination at the working positions of the operatives Both heating and lighting affect subsequent production costs through overhead expenses.

Where a fair proportion of the floor space will be occupied solely for detail manufacture by bench or machine operatives, it may be desirable to have the building say 15ft. to 20 ft high only, depending upon the roof span proportion, but in main component erection bays much greater height may be required.

(*c*) *Use of daylight.*

North lights in the factory roof were for many years considered desirable, but in the author's opinion are not as essential nor as advantageous as an abundance of windows round the factory side walls, with adequate space between them and adjoining buildings.

(*d*) *Position of doors, etc.*

Whilst appreciating that many other factors may have prior claim, it is felt nevertheless that insufficient attention has been paid in the past to the position of doors relative to the prevailing winds, particularly in the winter months. The doors may be small for the normal passage of pedestrian traffic, and generally in frequent use, or of larger types for the receipt or despatch of goods.

Door location is worth some thought, not only to ensure the comfort of the workers inside the factory, and particularly those near the doors, but also to reduce heat losses and the resultant costs of maintaining adequate even temperatures in cold weather.

The general layout of the buildings comprising the manufacturing organisation as a whole should be carefully considered, and, as mentioned earlier, as much attention should be paid to appearance as if it were a well-designed estate. There is nothing worse than a factory site congested with buildings of all shapes and sizes, located with little or no considered judgment. Almost without exception, one can assume that efficiency inside the buildings is comparable with the external appearance.

Usually several other buildings are required on a factory site besides that which has been referred to as the main manufacturing unit. These may include :—

Administrative and other staff offices.
Raw material stores with unloading, loading, packing and despatch bays.
Scrap metal handling and storage accommodation.
Clocking stations.
Cloak rooms, lavatories, and possibly rest rooms, especially if large numbers of female operatives are employed.
Paint spraying shops.
Plating, heat treatment and other process plants.
Boiler house, transformer stations, etc. Suitable fuel storage must not be overlooked.
Maintenance workshops.
Garage, especially if several cars and lorries are necessary for the business.
Canteen.

The internal appearance of the factory buildings is, if anything, worthy of greater attention than the layout of the site.

Whether it be workshop or office, it must be remembered that it is the place where the employees are compelled to spend most of their lives.

It is surprising to find how many factory buildings are left unfinished with bare brick walls inside. Earlier, ample side windows were recommended, and these should be of such a sill height as just to prevent persons looking in from the outside. Good electric lighting should be provided for the hours of darkness, preferably of the " artificial daylight " type, of which there are several really efficient systems on the market. It is recommended that specialist advice be obtained on the subject of lighting, for although standard figures of illumination ranging from 8 to 25 foot-candles are stipulated for various grades of work, these, in fact, can be most misleading. An expert can give valuable advice after studying the structure of the buildings, including the positions of beams and stanchions, and with due regard to the type of work to be carried out by the operatives in the various shops and offices. It would be interesting to know how many executives, having been entrusted with the task of organising new factories, have actually consulted the ophthalmic profession in addition to lighting experts.

The author advocates bright and cheerful as well as restful colour schemes inside factory and office buildings, for, whereas the latter usually have a certain amount of attention in this respect, the former only too often are entirely neglected. The colouring of interior factory walls with a carefully chosen green to sill height, and a pale cream above, goes a long way towards ensuring brightness and cheerfulness. Walls thus decorated are generally more carefully treated and employees are less liable to deface them by driving in nails, especially if benches, etc. are always situated so that there is a passage way between them and the wall.

The inside of the roof should also be coloured white or light cream if possible, although it is admitted that very often the maintenance of such a two-colour scheme might present difficulties.

It is a good plan to paint service pipes for compressed air, gas, water, etc. distinctively throughout buildings, and apart from appearance, such a scheme is highly recommended for the point of view of the maintenance personnel. Most factory executives will have their own ideas as to the colours to be used, but a useful guide may be found in BS 1710: 1951 "Colour Identification of Pipe Lines."

The internal layout of the main factory must, of necessity, be arranged primarily to suit production requirements. For this reason, such units as lavatories, being permanent structures, should be so situated as not to interfere in any way with possible future changes of production layout or factory extensions. Boiler plant and electrical installations should also be such as to enable additional plant to be provided, if required, for future extensions.

In Fig. 1. a general layout is shown with which extensions could be made to the length and breadth of the factory, whilst at the same time retaining the general symmetry.

Usually the stores are a fairly permanent structure, and, in the position shown, could be adjusted easily in size by the movement of the partition running transversely across the shop.

Except as regards machine shop and press shop plant, the whole arrangement provides elasticity of production layout, since the inspection bay, located as shown, would obviously be constructed with portable or semi-portable partitions.

The separate entrance for employees to shops and offices, as shown, has a distinct advantage over schemes where goods traffic to the factory has to use the same entry, and, in addition, ensures that the front entrance to the offices is not subject to continual use, with consequent premature dilapidation.

Every section of the factory buildings is important enough to warrant a certain amount of special attention. With due consideration, even boiler plant premises, etc. constantly consuming coal or oil fuel, can be so arranged as to facilitate the maintenance of cleanliness, and enable the operatives concerned to take a pride in their work.

It would be possible to mention numerous details which should receive attention, but here it is only intended to bring to the reader's notice a few at random, to establish the principle that whether organising a new factory, or making improvements in an older concern, the future

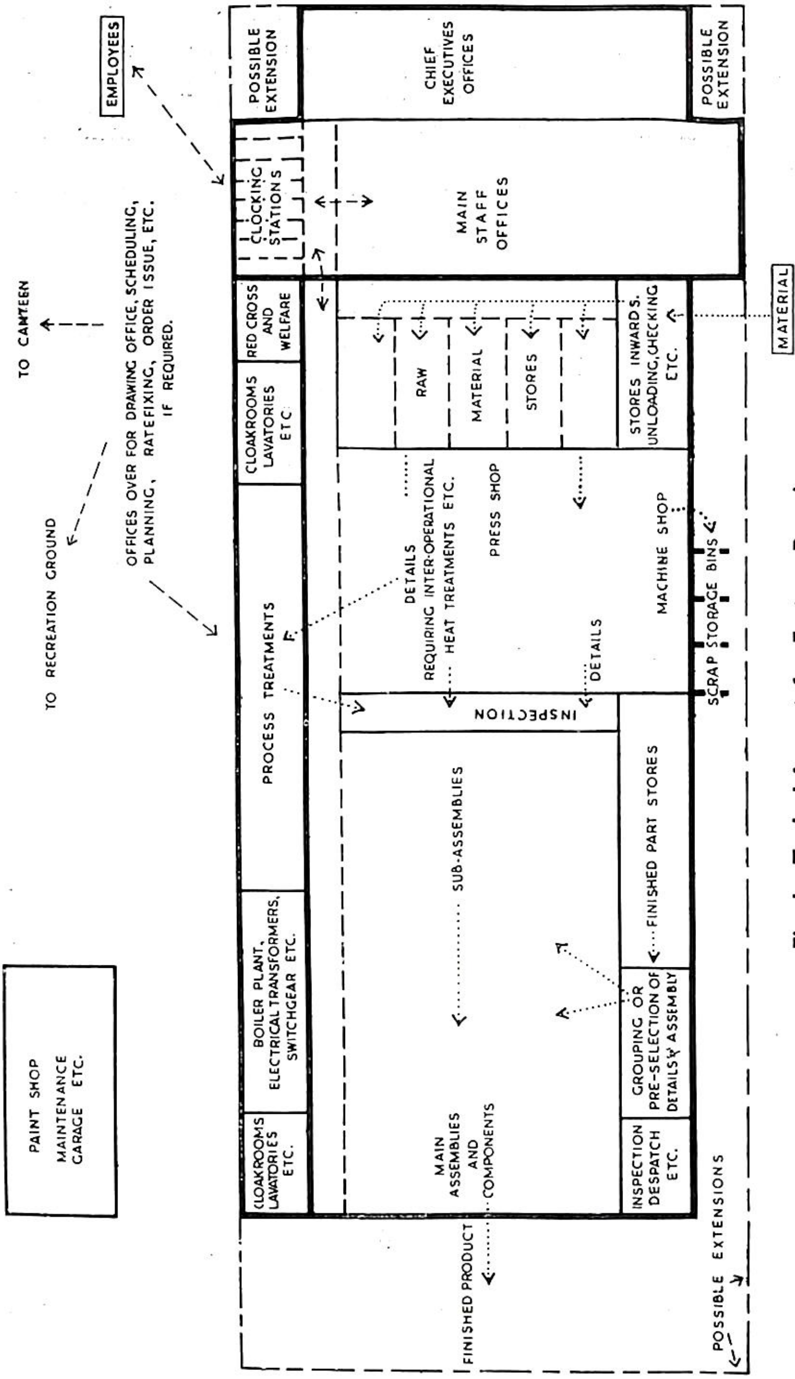


Fig. 1. Typical Layout for Factory Premises

cleanliness and efficiency depends largely on the interest displayed by the management, as judged by the humblest operative, in relation to the facilities afforded for his own particular job.

This explains why well organised red-cross rooms and welfare departments are so necessary to the factory. The welfare supervisor, carefully chosen for the work, must have facilities for private consultations, as must the red-cross personnel. The latter must even be able to deal with minor injuries and ailments of males and females separately. As regards the facilities to be afforded, managements hold diametrically opposing views. Obviously, however, if a dose of medicine or an aspirin, or perhaps half-an-hour's rest at the right time, prevents an operator being absent for a day or two and induces a feeling that the firm is really concerned with his or her health, the best policy is not difficult to determine.

The red-cross rooms should be tiled throughout if possible or at least to a height of about 5ft. and the remainder of the wall surfaces painted so as to be washable. There should be no corners or ledges, as a precaution against dust collection.

The equipment to be installed is, of course, dependent upon the money available, but if wisely chosen by competent persons, need not be excessive in proportion to the returns which can be expected from the services rendered.

Lavatory and cloakroom facilities should also be adequate. Whether the employee be a labourer or an executive, he is entitled to privacy, but from observations made, even in recent years, it is apparent that in some factories deplorable conditions still exist. Cloakrooms should have full facilities for drying clothes for employees who may get a drenching on the way to work, and a changing room should be provided. It is even suggested that the welfare department should loan items of wearing apparel whilst an operative's clothes are being dried, rather than that he or she should be compelled to work for several hours in wet clothes after an unfortunate soaking. All steps should be taken to avoid the necessity for employees keeping hats, overcoats, etc., scattered anywhere throughout the shops or offices. It will be found that near clocking-off times, supervision difficulties will be lessened if the use of cloakrooms is compulsory, and they should be under the control of proper attendants, to prevent pilfering. Separate lock-up containers for each employee are not a costly item.

The reader will already have formed the opinion that the author attaches great importance to buildings being designed to give the maximum facilities to the workers so that they can carry out their daily tasks under the best possible conditions. This cannot be over-emphasized and applies equally to employees in the shops and in the offices and to the staff. All workers can generally be relied upon to respond to environment in their output.

Offices should be light, with good heating and ventilating systems. Buildings should be as large as possible to provide adequate working area, and space should not be squandered by the unnecessary provision of individual offices. As with factory floor spaces, elasticity in layout is always to be desired, and efficiency as well as overhead expenses are greatly affected by careful planning. Attention should be paid to the class of work to be undertaken by the staff concerned, and the positions of desks, telephones, electric plug points, push bells, indicators and the like.

It must not be overlooked that the cleaning of the offices, usually by part-time workers in the evenings or early mornings, is a most important operation, and every facility should be provided for its prompt execution, with the minimum opportunity for dust collection in places out of reach.

There is one office, usually well known to the workshop hand, which calls for a separate mention, namely the " Labour & Wages Office," as it is usually termed. Here, those seeking employment invariably apply for jobs; through it they obtain admittance; and it is the last contact if they are paid off. Attached to the labour office there should be a separate room or lobby where applicants can wait, sheltered from the weather—waiting invariably seems to be a recognised part of the procedure—and, leading from this, a small room where private conversation can take place between the applicant and interviewer. It is not desirable that even an ordinary " hand," perhaps of mature age, should be interviewed in full sight and hearing of several other people, when wage matters and past history are discussed and recorded, sometimes by a very juvenile clerk. Such points are often forgotten, but the first impression of the future employee may have a lasting effect on his outlook towards the firm and upon the work that he does.

When he is paid-off, perhaps due to no fault of his own, he may have feelings outside the experience of those in control. Why should he stand in the queue outside the window or door with a small flap, through which he receives his wages due and " cards "? The welfare officer should be about—it should be with regret that his services are being dispensed with, unless it is a case of misconduct.

The Canteen

The canteen is a building which so easily can be " as cheap as possible," and passed over as relatively unimportant because it cannot show a direct return on capital. This attitude is exceedingly short-sighted. Canteens should compete with any other good class restaurant and can be far removed from a financial liability. Fig. 2. shows a typical suggested layout.

In the first place it is advocated that the building although primarily designed for accommodating employees comfortably at meal times, should be capable of other uses.

Reference was made earlier to factories being in close proximity to the workers' homes and being " in tune " with the surroundings. The canteen has its part to play in this connection, and should be suitable for concerts, dances, etc., outside normal working hours.

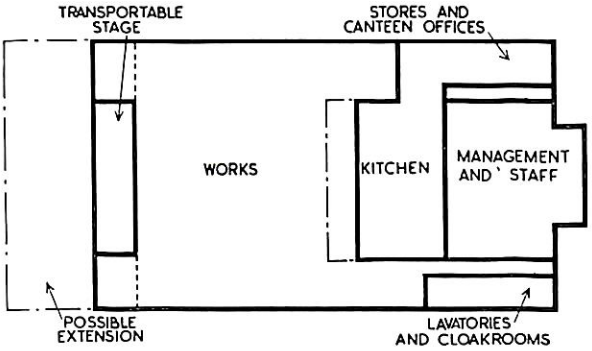


Fig. 2. Typical Canteen Layout

We have seen vast improvements in factory conditions, etc. in recent years, but at the same time a decided tendency towards estrangement between labour and management. This is to be regretted and the reason is worth consideration. It may primarily be due to the growth of very large industrial organisations.

Men and women, as a whole, lead happier lives in smaller communities. The dweller in a large city hardly knows his neighbour unless he belongs to the same church or club, but in villages an entirely different atmosphere prevails. This being so, it is suggested that a smaller community, centred round the works, can be of immense value in the lives of those connected with it.

In the large industrial undertakings it is obvious that workers as individuals feel farther removed from the " boss," and therefore every means should be adopted to obviate this impression which often is only too apparent.

In order to approach the relatively smaller communal life which the author feels should be fostered, he suggests that the works should be " in the community " through the canteen. The suggested recreation ground also can be included in the scheme.

Management can accomplish much in fostering activities in the field of sport, and indoor recreation of various kinds, to cater for the widely differing tastes of active participants and spectators alike, both during the summer and winter seasons.

Smaller sections definitely interested in some particular game or recreation can usually be relied upon to organise themselves in order to satisfy their individual requirements and interests, and each section can form a tributary of the main stream represented by the " Sports Association."

Typical sections can be formed as follows :—

Miniature Rifle shooting
Darts teams
Chess
Dramatics
Debating and literary
Musical
Table tennis
Indoor hockey
Skating
Gardening
Football
Cricket
Cycling and motoring
Athletics

Quite often, arrangements can be made with other bodies, such as local authorities, whereby special facilities are afforded in the way of reduced fees for the use of, say, a swimming bath or even a golf course.

It is advisable to give consideration to a man's family ties, and advantages can be derived from giving opportunities for wives and even children of employees to become members, and be actively associated with suitable sections of the Club.

Such recommendations as these, if adopted, do not necessarily mean a large expense to the company. It is merely suggested that certain essential facilities should be provided, and the employees encouraged to organise their " Sports Association," etc., to the funds of which they will usually subscribe liberally through the particular sections in which they are mainly interested.

The management should show genuine interest in all the activities, participating as and when possible, and be sufficiently involved to foster the correct atmosphere at all times without wishing to control, as is obviously necessary during working hours in the factory, but in such a way as to give tactful advice and guidance to ensure smooth running.

By such means, the wheels of industry can be well lubricated, and the whole relationship between management and labour lifted to a higher plane.

CHAPTER 2

THE FACTORY ORGANIZATION

In the previous chapter an attempt has been made to indicate as simply as possible, a few salient points in connection with the layout of factory premises. The majority of people have to work for a livelihood, and every possible amenity should be incorporated to create interest, enthusiasm and happiness in work, as well as goodwill amongst all concerned. At the same time an efficient organization must be set up if the business is to be successful, and upon this success depends the employment of the community.

It is not intended to discuss the controversial subject of the financial background of the company—whether it should belong to the State or private individuals.

What is necessary is a carefully developed " family-tree," on the branches of which are the names of suitable persons who can fully justify the positions they hold, and who, together, form the team without which no undertaking can be expected to progress.

Reference has been made previously to the manager or chief executive. This term has been used symbolically, for the correct title may be one of several—president, chairman, managing director or general manager, etc. For our purpose this is of little importance. What is obvious is that one person must be, in the fullest sense, " in control," with full-time occupation on the premises and in constant personal touch, and it is sufficient to refer to him as the " manager." Working immediately under his direction are the chief departmental executives, from whom radiate the various sections and sub-sections, forming the network of what is called the " organization."

The framework of the organization can be greatly influenced by :—

1. The type of product with which the factory is concerned.
2. The size of the undertaking.
3. The capabilities of persons available for various supervisory duties and positions of authority and control.

In addition, there may easily be several alternative methods of arranging the organization " set-up " without materially affecting the efficiency and much may depend on the previous experience and opinions of the manager, to say nothing of his actual ability.

Generally speaking, however, all undertakings of the type under consideration require a similar basic structure for their organization, and this will be examined.

Firstly, the manager, through his subordinates, should be concerned with :—

(*a*) The workpeople.—These must be engaged for the various groups of duties to be carried out. They must be given at least reasonable conditions in which to work, and be supplied with the necessary equipment to enable them to perform their particular tasks.

They must be paid on a fair and reasonable basis for their output, and measures must be taken to record accurately all the necessary data relating to time spent, work accomplished, and wages due.

(*b*) Materials.—Something cannot be produced from nothing and therefore to some department or departments must be assigned the duty of obtaining the primary materials. These may be of the type generally referred to as raw materials, or finished parts manufactured elsewhere. The materials required must be known, they must be ordered, they must be received, and they must be paid for.

Records must be kept so that once the materials have been received into the factory stores, it is known what quantities have been requisitioned for use, and for what purpose. The remaining stock must be readily ascertainable and balanced against future requirements, to permit of exercising control over future ordering, etc.

(*c*) The work to be accomplished.—This probably affects departments concerned with the initial design of the product ; the design and manufacture of the requisite jigs and tools ; the distribution of the work to individuals or groups of individuals, together with the necessary data as to how, when, and where it should be done ; the regulation of the supply of materials to the operatives, and the collection of their work when finished ; the inspection of the work to ensure that it is correct and of approved standard. The appointment of suitable persons to supervise the various sections and sub-sections of the organization to deal with these matters, is obviously important.

(*d*) The commercial aspect.—It is useless to produce unless orders are received and there is a market for the goods. In general, orders will only be forthcoming if a suitable quotation for price and delivery has been submitted to, and accepted by, the customer. To do this, it must be possible to estimate costs with reasonable accuracy, and these estimates should be compared with actual figures during or soon after the completion of the work. Estimates of availability of labour, floor space, materials and equipment must also be prepared, so that a reasonably close estimate can be made of the work that can be undertaken. Repeat orders may not depend only upon price and delivery estimates, but also on the reliability of the product and the consequent satisfaction of the customer. A follow-up liaison in the form of a separate sales and service department is usually desirable.

Advertising will probably be necessary to bring the product and its qualities to the notice of prospective purchasers.

(*e*) Secretarial business.—This covers mainly the legal and financial aspect of the undertaking. The running expenses relating to heating, lighting, rates and taxes, maintenance, depreciation of buildings and plant, salaries, etc., must be carefully watched. Accounts must be rendered and invoices paid. The direct labour expenditure and material costs in connection with contracts in hand must be analysed and studied in conjunction with overhead costs. The business cannot exist for long if showing a financial loss.

The above constitute what may be termed the main arteries of the system. They should not, however, be allowed to become separate water-tight compartments of the organization, each containing a number of departments, but as will be explained later, must be combined to form a completely interwoven network of sections. These sections may, in general, be separate units with a tendency to " water-tightness " and often are more efficient if allowed to be so, under correct guidance, while at the same time working to systems and procedures which " tie-in " with the over-all scheme of the organization.

The efficiency of these small sections governs the over-all efficiency more than is generally realised. Only too often they are controlled by underpaid section leaders, who would be markedly more successful if their superiors understood more fully exactly what routine detail matters—vitally important ones, and perhaps governing costs more than is generally realised—were being attended to. Here it is that the numbers of staff can grow without being observed at once. Here it is that the cheapest staff, put to work on something relatively unimportant but apparently necessary to the business, with no thought to a definite period of training, simply will not suffice if efficiency in the whole organization is aimed at.

It is possible to have in control of, say, design and production departments the most highly qualified personnel, but should a junior be left to type orders to the shops, showing the quantities required, etc., can that junior be blamed for inadvertently substituting 10 off for 1,000 off ? He or she often has to copy from almost indecipherable pencilled notes, and frequently adequate checking is dispensed with on the score of cost. It is essential that the junior should be given every opportunity to learn the origin of an order and the subsequent stages through which it has to pass in the fulfilment of its purpose.

It is not sufficient that the training of juniors should be left entirely to sub-section or section leaders, who also may be rather youthful, in order to achieve a reduced wage bill. A system of periodical personal checks should be instituted by departmental heads and even higher officials.

Before attempting to frame the organization structure, the departments or sections which appear to have more or less separate functions to fulfil will be listed on the basis of the groups previously mentioned. They are not necessarily in any fixed priority, nor grouped in any particular sequence with reference to the organization frame-work which will be finally suggested. They are, however, placed in a sequence following approximately the route of a piece of material which is to be manufactured into a finished article :—

Design	To prepare the initial scheme or conception of what is to be manufactured.
Design drawing office	To put the schemes into practical form on paper to enable prototype or experimental manufacture to proceed.
Production drawing office	To re-draw or re-group prototype drawings in a manner suitable for larger production batches.
	To keep drawings up-to-date in respect of dimensional errors found, etc., or variations agreed upon to facilitate production.

	To prepare all parts lists, etc., for various breakdowns or assemblies and sub-assemblies, so that the various units can be suitably controlled against production programmes and cost requirements. To schedule material requirements for economic utilization, and for ordering purposes.
Methods department ..	To decide how an article is to be made, and prepare process sheets, etc. To advise on all tools and equipment required.
Jig and tool drawing office	To design all jigs and tools required, as called for by the methods department, and to prepare schedules of materials required for them.
Planning department	To prepare programmes of production to be met by the various manufacturing departments, and issue information as to when work has to be commenced and completed. To prepare all shop layouts and statistical data regarding plant, jig, and labour loading. To control the issue of work to the shops in suitable batch quantities and in a sequence designed to preserve as far as possible " balanced production " of the various components, etc.
Estimating and ratefixing	To prepare information as to grade of labour to be used for various operations decided upon by the methods department, and the time to be allowed. To prepare information required by the quotations department.
Buying department ..	To receive information regarding all requirements of materials and equipment for the various departments, obtain estimates, etc. and place orders with suppliers.
Stores	To receive all materials from outside suppliers, check against advice notes and notify receipts to all other departments concerned. To store materials in suitable bays, bins, etc. for ready use and in such a manner as to prevent damage. To control the issue of materials to the manufacturing departments in accordance with instructions from the planning department.

	To receive and act upon information concerning all despatches to be made.
Stores records	To retain all records of materials in stock, and the prices of such materials. To provide information for re-ordering items when approaching "minimum stock levels."
Labour and wages office	To keep all records of applications for employment, and receive notification from all departments as to staff required: arrange interviews for departmental heads, etc. To arrange the official signing on of employees on behalf of the firm. To deal with all official regulations relating to employment as laid down by Government Departments, Trade Unions, etc., be responsible for the display of information on works notice boards, etc.; and notify departmental chiefs. To control all records of hours worked by employees, the deductions for national health and insurance schemes, etc. To control the preparation of all wages sheets, and wage payments.
Quotations	To collect all information relating to labour and material costs, delivery promises, etc. and prepare quotations for submission to prospective customers.
Sales	To receive all orders into the firm and inform the necessary departments for action. To record despatches against commitments and ensure that deficiencies, etc., are speedily made good. To control official contacts and liaison between firm and customers.
Factory order issue	To issue works orders to the shops for manufacture to proceed in accordance with instructions from the planning department.
Progress	To control movement of all work in progress after raw materials have been issued from the stores. To retain records of progress of work in relation to the programme of requirements laid down by the planning department. To anticipate shortages of parts and materials or any probable failure to meet commitments, and notify the departmental chiefs concerned.

	To issue instructions to stores regarding despatches.
Inspection	To ensure that all materials, etc. received are correct to specification. To control the standard of workmanship during processes of manufacture, and guarantee that such standard is maintained throughout the sequence of operations. To verify that all goods despatched are correct to requirements and suitably packed or crated for transport, etc. To check all jigs, tools and templates, etc. and ensure that parts manufactured therewith are dimensionally correct.
Costs	To control the recording of all necessary manufacturing costs (labour and material) and prepare summaries as required by the accounts and quotations departments, etc. To arrange with the wages department, as necessary, the reconciliation of labour costs booked to various jobs with wages paid.
Accounts	To prepare all data relating to overhead charges. To analyse all cost summaries during the period of manufacture and on the completion of jobs, and prepare statements of profit and loss as necessary. To record all payments of accounts and payments received. (Usually a cashier or chief accountant deals personally with salaries, etc. of higher executives.)

The actual grouping of these departments to form a structure must depend a great deal upon the size of the organisation, as well as upon the class of industry with which it is concerned.

In general, the most desirable grouping for efficiency would probably be :—

DESIGN

Research and Formulation of Schemes

Strength and Weight Calculations

Drawings for Prototype and Experimental Work

Experimental and Testing Work

PRODUCTION

Production Drawing Office

Amendments to Drawings to facilitate Production
Re-grouping of Drawings into suitable units for Production
Preparation of Parts List Summaries
Material Scheduling
Grouping of Materials for Ordering

Methods Department

How and with what a Part has to be made
Plant and Equipment Data—Existing and Required
Jig and Tool Design
Ratefixing

Planning

Programmes of Production Requirements
Shop Layouts
Time Cycle Study and Determination of Batch Quantities
Machine Tool, Floor Space, and Labour Loading Statistics
Issue of Work Orders to Shops

Works Supervision

Jig and Tool Manufacture
Production Manufacture
Maintenance Departments

Progress

Jigs and Tools
Manufactured Parts
Finished Parts Stores
Pre-selection of Parts for Assembly Stages
Spares and Service

MATERIAL SUPPLIES

Buying Department

- Raw Materials
- Proprietary Articles
- Plant and Equipment
- Stationery
- Miscellaneous Purchases for Canteen, Welfare, Red Cross, etc.
- Materials Progress

Stores

- Inwards
- Custody and Control of Internal Issues
- Goods Despatched

Stores Records

- Stock Quantities
- Pricing

INSPECTION

- Materials Received
- Jigs and Tools
- Manufactured Parts
- Goods Despatched

SECRETARIAL

- Correspondence
- Accounts
- Labour and Wages
- Red Cross
- Welfare
- Canteen

COMMERCIAL DEPT.

Sales

- Enquiries
- Quotations
- Orders Received
- Service and Spares
- Transport
- Publicity

Works Cost

- Labour
- Material

Variations of this grouping, to accommodate particular cases, and yet at the same time preserve the necessary cellular structure, are shown in Fig. 3, 4, 5, 6, and 7.

Firstly, in Fig. 3, we have an organization structure which is recommended for a small unit, employing up to a maximum of about 500 persons (works operatives plus staff).

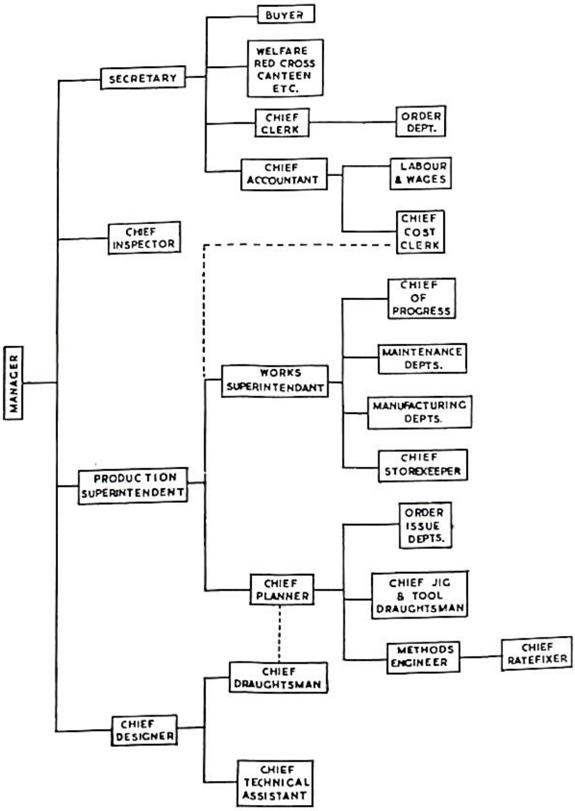


Fig. 3. Organization Structure for a Small Factory

It will be seen that here there is no separate unit for the preparation of production drawings. Close liaison with the chief planner is then essential so that practical production requirements can be catered for by the drawing office.

The proportion of shop operatives compared with staff will tend to be smaller for a small manufacturing unit of the size mentioned, and therefore the production superintendent will control both planning and manufacture through his two chief assistants, the chief planner and the works superintendent.

The inspection department, regardless of the size of the factory, must not be under the direct control of the executive responsible for the actual manufacturing departments, and this is clearly indicated on all the variations of the organization structure given as examples.

For efficient production control there must be close contact with the costing department, if not full control of it, and it is important that the latter should function with the prime object of assisting production control, recording costs of a type and by a system which will at the same time give up-to-date data as required by the chief accountant. Further reference, however, will be made to this matter in a later chapter.

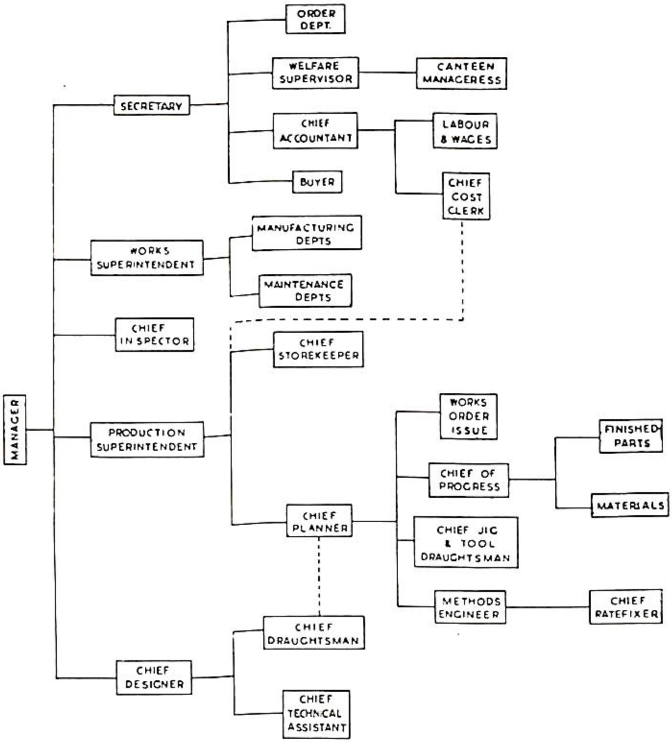


Fig. 4. Organization Providing for Production and Works Superintendents Both Directly Responsible to the Manager

From Fig. 3 also, it will be observed that the secretary controls the commercial and sales section, but this may not be desirable in the case of a factory concerned with speculative manufacture, where perhaps much depends upon advertisement and service. In such instances a separate commercial department will almost certainly be necessary.

Referring now to Fig. 4, it is envisaged that the works operatives are proportionately stronger numerically, and this calls for executives to exercise, separately, supervision over the manufacturing departments; therefore production and works superintendents are included, both directly responsible to the manager.

It will be seen that the control of stores has passed to the production superintendent, this being due to the fact that a relatively small variety of types of raw material has been assumed, which is quickly converted into large quantities of finished parts. The progress department should preferably exercise supervision over the collection of these parts into stores, and it is recommended as a more efficient means of contact, particularly for the despatch of finished goods, that the progress and stores should be in the same main group of the organization.

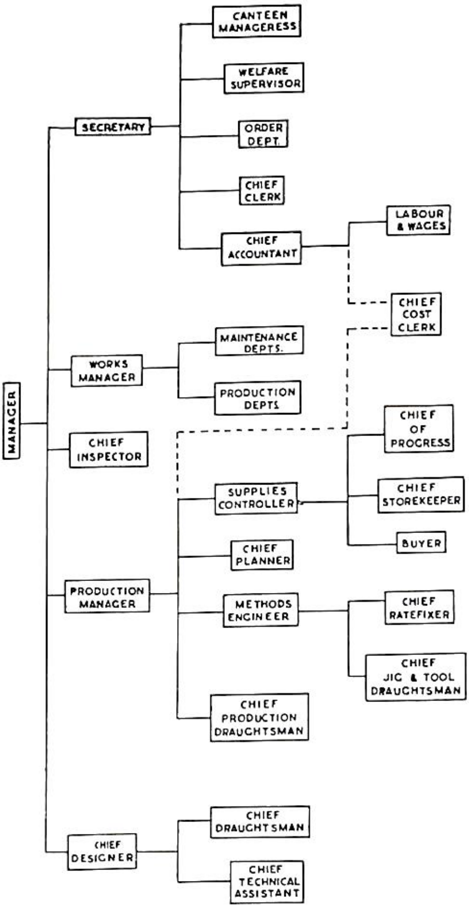


Fig. 5. Here Additiona Responsibilities have been Transferred to the Production Manager

In a sense the same remarks apply to the progress department itself, but individual circumstances must be the deciding factor regarding the apportionment of responsibilities as between the production and works chief executives.

It will now be assumed that a larger organization altogether is concerned with manufacturing a product involving the preparation of drawings in such a form as to enable the " first off " or prototype models to be built as quickly as possible, and, as usually happens in such cases, the actual construction proceeds concurrently with the preparation of these drawings. It is impossible in these circumstances to expect the drawings to be suitable immediately for use for moderate or large scale production purposes. Errors in dimensions must be expected and found. Mating parts must be cross referenced to each other and to jigs and templates, since the original limits allowed will probably not guarantee interchangeability for assembly. Many such factors, as will be explained later, demand a special drawing office for the prototype and experimental work, together with, as shown in Fig. 5, an entirely separate drawing office, under the control of the production chief, the function of which is to " productionise " the original drawings. This separation of drawing office control, is a very controversial subject, and will be left at this juncture for further consideration in the appropriate chapter.

However, proceeding with the organization chart shown in Fig. 5, it will be seen that the greater expanse of the production manager's

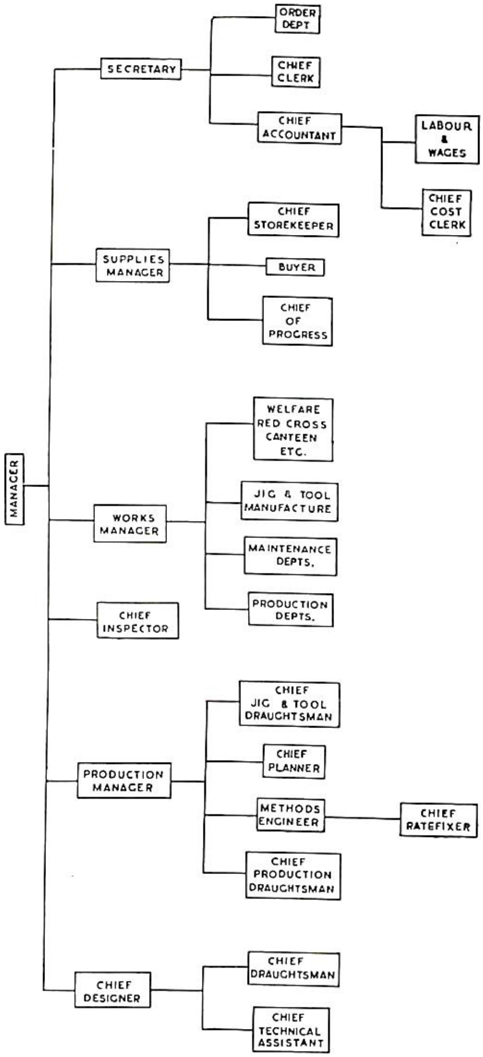


Fig. 6. Enlargement of the Supplies Department has Necessitated the Appointment of a Supplies Manager

supervisory field, entails a larger number of senior departmental heads responsible to him. In particular it will be observed that the creation of a separate "supplies" section has resulted in the transference of the actual purchasing of materials, etc. away from the secretarial group. The increased status of the methods engineer will also be noted—this will be necessary since the chief planner will have a correspondingly important task to supervise the factory layouts, shop and plant loading, and the actual placing of the orders for manufacture in correct sequence and quantities.

This general set-up will cover organizations having a total personnel strength of 2,000 upwards, but dependent upon various factors previously mentioned concerning types of product manufactured, etc. will require to be modified as shown in Fig. 6 and 7 according to circumstances.

In Fig. 6, the supplies department has been enlarged sufficiently to warrant the supplies manager being a separate senior executive. Although this is not actually indicated, the factory may be concerned with the fabrication of assemblies, etc. from parts which are sub-contracted to other firms. The placing of sub-contract orders and the supply of materials for them, etc. may become a job of such proportions as to necessitate a sub-contracts manager, who should, however, be within the supplies manager's group.

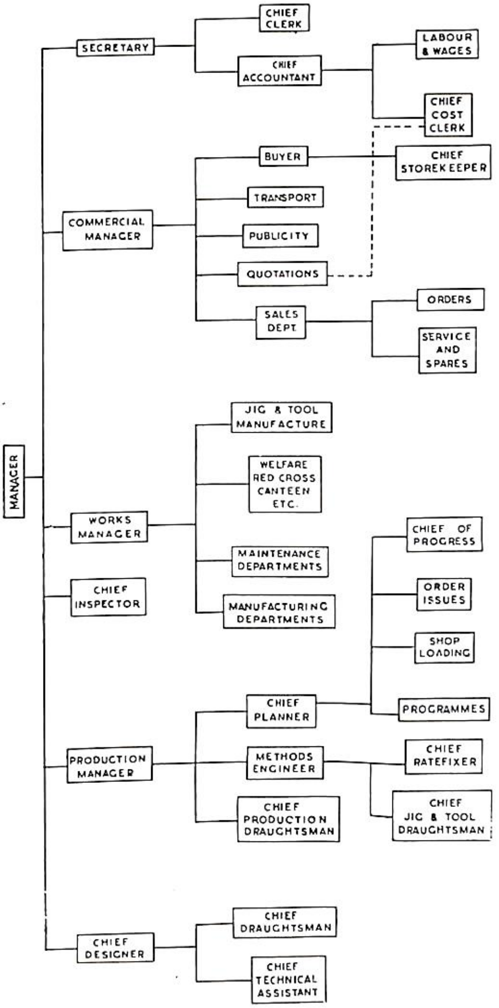


Fig. 7. An Organization Structure Including a Commercial Manager.

Fig. 7, indicates an organization structure in which it has been found necessary to include a commercial manager. This particular group, as diagrammatically portrayed, may not, however, suit all requirements, and therefore the possibility of a compromise should be investigated, particularly in connection with the supplies department as shown in Fig. 6.

Summarising, it is suggested that, in general, small or medium manufacturing units may best be organized as indicated in Fig. 3, 4 and 5, while large organizations, and groups of units, require supervision and allocation of departmental control along the lines of Fig. 6 and 7.

It is important that throughout the organization, the departmental chiefs, whether they be of high or only intermediate status, must be active "workers" and not merely "static figureheads." They must, individually, have a clear and concise knowledge of the detail work to be done in their departments, and engage the minimum of staff for the efficient execution of this work.

The building up of a top-heavy office structure is not only a wasteful burden on the overhead costs, but its repercussions pass too quickly through the shops to the manual operatives.

The departmental head who knows his job and gets out of his staff a good day's work for a fair day's pay, will know when an increase in staff is really necessary as an alternative to systematic overtime for those already engaged, which is always to be avoided as most undesirable.

CHAPTER 3

THE ORGANIZATION AT WORK

In this chapter some of the more important points in connection with the actual functioning of departments will be discussed, with typical examples of the paper work which may be necessary.

The arrangements for paper work should not be dealt with lightly, as duplication of records can so easily result, necessitating the employment of additional staff. It is not uncommon to find that insufficient elasticity has been allowed in a system and the relevant paper work, so that the system is being continued in its old form when modifications would be advantageous, simply because large stocks of forms, etc. are in existence and not suitable for adaptation.

It should also be noted that not infrequently new or modified systems can be introduced, without ensuring that the old system is entirely displaced. This causes inefficiency in many establishments of long standing, and has at times been the sole reason for the chaotic state of records sometimes found to exist.

A system should always be built up from first principles with due regard to requirements, and be as simple as possible. It is always a good plan to employ temporary paper work at first, by designing the requisite forms, etc. so that typed masters can be prepared and copies run off as required with an ordinary duplicating machine. There are several varieties of such machines, which could be recommended, and a factory organization of any size will find one almost indispensable.

Such a procedure allows the system to be tried out at very little cost, and alterations found necessary can be quickly introduced. There should be no haste to " go to print " with the final forms—this should be left until ample time has elapsed for proving and establishing what is best.

Despite the reference in the previous chapter to the " water-tightness " of certain departments, it would be unwise to allow all departmental heads to institute forms, etc. as and when they think fit. A procedure should be established whereby any suggested new form should be put forward as a proposal to a committee of the higher executives, or a committee delegated by them, representative of all main departments, so that a degree of standardisation may be achieved. This committee should consider the use to which the form is to be put, and should have the authority to reject it if it is considered unnecessary, or, if it is proposed that it should be amended in any way, refer the matter back to the department of origin. When finally approved, the form should be accorded a reference number, from some central register. Every department should maintain up-to-date, a file of all sample forms used by the various departments, with a descriptive note attached regarding the use of each.

Care should always be taken to have record cards of the same size as far as possible, even if it entails an apparent wastage in certain instances. Inter-departmental memorandum forms should also be standardized.

Reference has been made previously to the layout of the factory, so that the processing of the materials during the various stages of manufacture follows a progressive " flow." This principle must be applied also to offices, and is equally important if anything like a reasonable degree of efficiency is to be attained. Due regard must be paid to the processing of the paper-work through an office, and the tables and desks, etc. positioned accordingly.

While on this subject, there are one or two interesting points which are worthy of consideration, and which are only too often, perhaps, regarded as so trivial that they are neglected entirely.

Consider, say, an office concerned with the issue of manufacturing orders to the departments in the factory. There may be a contract on hand for a number of large components, each comprising, perhaps, several thousand sub-assemblies and details. The details will have to be made in batches of varying sizes according to capacities of labour and plant. Sub-assemblies built up from these details will be required at different stages during the full time-cycle of manufacture for a complete major component.

All this information will be calculated by the methods and planning departments, and supplied to the order issue department in the form of an issue schedule, which will indicate when, and in what sized batches, the work must be commenced, so that all the parts will be available at the time required. The issue department must ensure that the necessary orders, together with all the other relevant documents—process sheets giving operations to be performed and times allowed, jigs and tools required, material requisitions, drawings, etc.—are sent to the appropriate manufacturing centre by the time required. These documents are only mentioned by way of example, and must not be interpreted as covering the actual paper-work one would collect together in the issue department—this will be discussed later in connection with the best policies to be adopted.

The issue department, however, will be receiving information from other offices, collecting it into groups, and entering the necessary data on appropriate order forms, etc. and will be responsible for issuing it to the stores and shops so that manufacture can commence.

It will be necessary therefore to have first of all an inwards record section, followed by various sections of the office through which the information flows, and the documents to be issued are compiled and converge on the actual issue section. Here, a further record system must be established, so that it can be ascertained quickly when and where the orders have gone.

The personnel connected with the various operations in the office should be suitably positioned so that the documents proceed in correct sequence to the despatch point. Desks should be in neat and orderly rows, and it is always advisable for all persons to face in the same direction, with the one in charge behind them all and therefore not in full view of the office when his superiors visit him, etc.

When large open offices are available, accommodating several departments, each must be lined up to conform to a carefully laid out plan, and a suitable notice board should be displayed prominently to indicate each department. Where section leaders, etc. are not supplied with private offices, and this should always be the rule whenever possible, a small indicator should be attached to the desk of each, stating name and position. This is very helpful in any organization, not only to ensure that persons from other departments know who is in charge of a section, but especially for the benefit of visitors from outside firms who are otherwise often not sure to whom they happen to be speaking, nor how to spell the name of the person with whom they may have to communicate later, unless they ask for such information.

Private office doors should always indicate the occupier's name and position, for similar reasons.

Wherever possible, typists' pools should be arranged as this not only tends to reduce the number employed, but also enables typing rooms to be suitably partitioned off from the remainder of the office staffs who are thus relieved from distracting noise. Another interesting outcome of a typists' pool, is that the number of unnecessary memoranda between persons in the same office block is reduced. It is surprising, when making an investigation into office efficiencies, how often one can find a person dictating short notes to his typist, to send to another person only a few desks away. Even if a record of the information given is necessary, it would often be more economical to write the communication by hand in a duplicate " memo " book.

In conjunction with the typists' pools also, it is important to establish throughout the various offices a standard coding system for letter references, and as far as possible, similar schemes for filing correspondence, etc.

No general rules can be given for the actual codes, etc., since much will depend upon the type of organisation and the subject matters dealt with, but it will be obvious that, as references are used for identification of replies received, they must indicate :—

(*a*) Department of origin.
(*b*) Person who dictated the communication.
(*c*) Subject matter.
(*d*) Sequence number of correspondence.
(*e*) Person who typed the letter.

As an example a reference representing the above could be :—

P/AJ/S23/528/EM where say:—

P represents planning department.
AJ are the initials of the section leader.
S23 is the code number of the subject matter, used also in the filing system.
528 is the sequence number in the general file.
EM are the initials of the typist.

It is always advantageous to have a general file containing a copy of every letter and memorandum in numerical order, irrespective of subject, for quick reference within the office, especially when it is difficult to decide in which file to retain the copy. This is sometimes the case when a letter deals with several aspects of a subject.

Incidentally the " numerical file " copy should always indicate where the " proper " copy is filed, and when replies are received and filed, the appropriate information should be recorded on the numerical file copy also.

Filing systems, again, will depend on the type of work and subject, etc., but in order to allow elasticity, a good general rule is to file according to subject, and sub-divide as required. Thus, in the example just quoted, S23 indicates the subject, and the files could be arranged :—

S23/A/1
S23/A/2
S23/B/1
etc.

At any time an additional file on sub-section A could be inserted in its right place without interfering in any way with the sequence of the files. Each filing cabinet must, of course, have an index sheet attached, showing each file number and its subject, so that a particular file can be detected easily. Files which are used by a number of people in what might be termed a common office, should be in the control of one person only, who should be responsible for the care and general tidiness of the documents, etc., and who should receive a signature from the person wishing to withdraw a file for use.

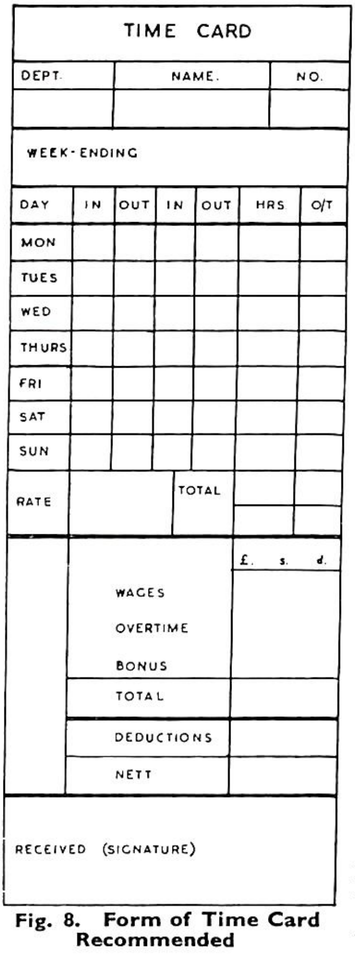
The general rules therefore, for efficient office organisation, can be summarised as :—

(*a*) A planned layout for location of personnel to allow for a flow of work through the various stages.
(*b*) General tidiness—regular rows of desks, avoidance of indiscriminate location of racks and filing cabinets, etc.
(*c*) Grouping of persons performing similar duties such as typists and general clerks.
(*d*) Avoidance of too many private offices.
(*e*) Adoption of large offices to accommodate staffs of several departments as far as possible, even if temporary glass partitions are used between the departments. This allows for easy re-arrangement, if necessary, should a change of programme cause some departments to decrease in size while others increase.
(*f*) Standardisation of reference codes for correspondence and filing systems, etc., as much as possible.
(*g*) Prevention of unnecessary circulation of internal departmental memoranda, etc., with resultant wastage of paper and accumulation of unimportant copies in files.

Next, some typical examples of the paper work which might be regarded as being of general application will be considered. As mentioned in the opening pages, the object of this book is partly to be of guidance to the "probationer executive" and he must use his own initiative in developing, from general principles, systems to meet the particular circumstances with which he is confronted.

The examples which are discussed are not necessarily grouped departmentally, as this would be difficult in view of the inevitable variations in the departments. These, as previously explained, depend upon the size of the organization and many other factors. More specific forms will be considered later when dealing with production control, etc.

Time Card—Fig. 8



TIME CARD

DEPT.	NAME.	NO.

WEEK-ENDING

DAY	IN	OUT	IN	OUT	HRS	O/T
MON						
TUES						
WED						
THURS						
FRI						
SAT						
SUN						

RATE		TOTAL		

	£. s. d.
WAGES OVERTIME BONUS	
TOTAL	
DEDUCTIONS	
NETT	

RECEIVED (SIGNATURE)

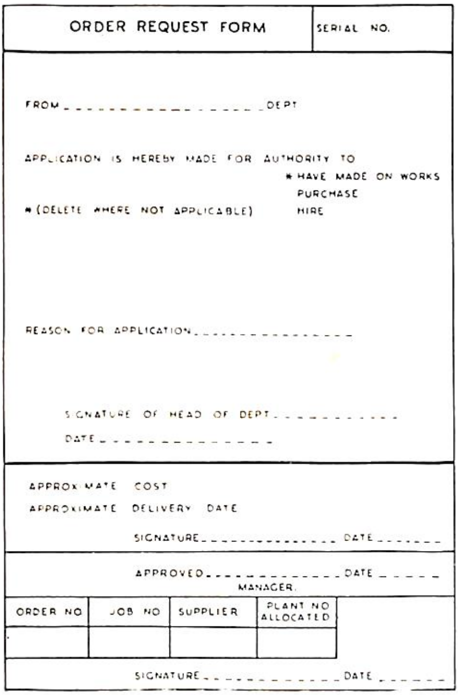
Fig. 8. Form of Time Card Recommended

It is essential, of course, to record the times of operatives entering and leaving the factory, for the making up of wage sheets. The usual practice is to allocate a card bearing a number to each individual which he or she takes from a rack when passing through the clocking station at the factory entrance, inserts in a clock-operated machine which automatically stamps the time in the appropriate space, and then deposits in another rack. This system is quick and easy to organise, and the time clerks can collect the cards during the day, note the information they require, and leave them in readiness for the operatives when stopping work. Fig. 8 shows a typical card used for the purpose. At the end of the week it is used to record the summary of wages due, and if it is handed to the individual a few hours before wages are paid, he or she can see exactly what is to be received and sign as a receipt, giving up the card in exchange for the pay envelope.

There are other systems in operation, such as the picking up of numbered metal or wooden discs from suitably arranged trays in a "muster-station," and depositing them in similar trays in the various shops or departments. In this way, by closing the trays at fixed times of commencing work, it can be readily determined which operatives have not arrived on time.

Such persons are only allowed to take their discs after fixed intervals of say quarter-of-an-hour. The disc is used when leaving work on pay days, as a receipt for the wage packet, in the same way as the signed time card.

The time card system is more favoured in these days, but the disc system is a better control, ensuring that the operatives arrive at their place of work at the correct starting time. Although a person has clocked on satisfactorily at the factory entrance, it may be possible for some time to elapse before he or she actually arrives on the job. The discs afford a control in this respect in so far as the trays in which they are deposited by the workers can be closed by a time-keeper at the appointed time, and discs not deposited then indicate late arrivals. The time card system can meet this requirement if the clocks are situated in the departments, but whereas these require to be fixed structures, the disc trays can rest on temporary trestles, and be removed easily out of the way during working hours.



ORDER REQUEST FORM SERIAL NO.

FROM ________________ DEPT

APPLICATION IS HEREBY MADE FOR AUTHORITY TO
* HAVE MADE ON WORKS
PURCHASE
* (DELETE WHERE NOT APPLICABLE) HIRE

REASON FOR APPLICATION ________________

SIGNATURE OF HEAD OF DEPT ____________

DATE ______________

APPROXIMATE COST

APPROXIMATE DELIVERY DATE

SIGNATURE ______________ DATE _______

APPROVED ______________ DATE _____
MANAGER.

ORDER NO	JOB NO	SUPPLIER	PLANT NO ALLOCATED

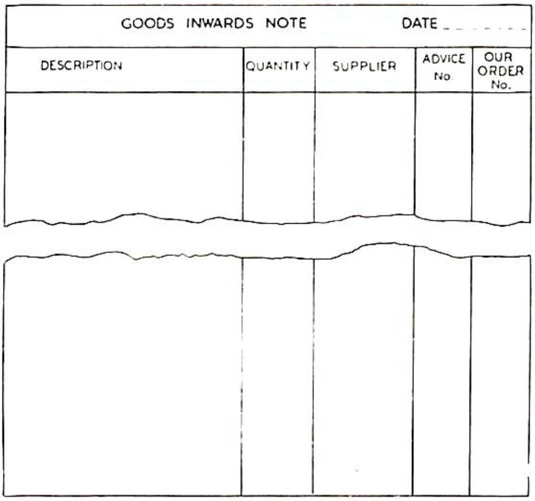
SIGNATURE ______________ DATE ______

Fig. 9. A Typical Order Request Form

Order Request Form—Fig. 9

This form is referred to, not only for the specific purpose which will be mentioned, but in order to emphasize the necessity for standardizing methods in all departments which have sometimes to deal with similar matters. All departments, whether in the shops or offices, will require at times certain items of plant or equipment which do not normally come within the " in-stock " category, and the departmental chiefs concerned should have a regulated procedure whereby their requests may be dealt with promptly. It is therefore desirable to have a standard request form in operation, with a recognised channel through which the application receives attention, is approved or disapproved by the management, and orders are placed. A typical form is shown in Fig. 9.

These forms should preferably be in duplicate books, so that when they reach the purchase department, one copy can be detached for retention, and the book returned to the departmental head concerned, who is then able to see that his application has been successful, and the order placed. It is advisable to relate the Order No. to the Serial No. of the application, to facilitate the procedure for notification by the stores when the goods are received.



GOODS INWARDS NOTE DATE _ _ _ _ _ _ _

DESCRIPTION	QUANTITY	SUPPLIER	ADVICE No.	OUR ORDER No.

Fig. 10. Goods Inwards Note

Goods Inwards Note—Fig. 10

Systems by which stores notify the departments concerned that goods have arrived, vary considerably. It will be apparent, however, that in any efficient organization the notification must be officially communicated in writing, and not done verbally. Delays must be avoided, and attention is therefore necessary to ensure that goods are unpacked promptly, checked and correctly entered as received.

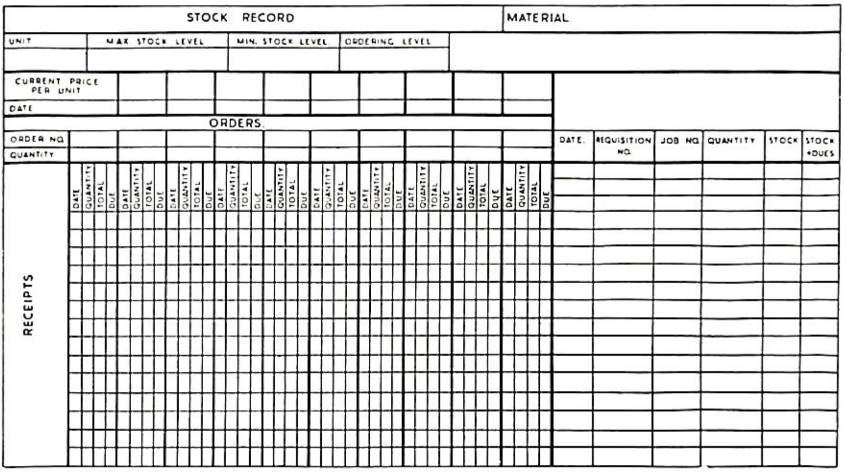
In some factories, all goods, regardless of class, are entered on a goods inwards sheet in the order of unpacking and checking, and a number of copies are circulated so that departments can record those with which they are directly concerned. In some cases this is the better policy to adopt, but only prevailing circumstances can decide whether it is preferable to the use of goods inwards notes graded to suit different classes of materials and other goods, so that with the use of a colour scheme for the sheets, fewer copies need be circulated. The latter system places more reponsibility on the stores inwards personnel, and unless well organized, can result in delays in notification.

Stock Record Card—Fig. 11

The up-to-date recording of stock is of the utmost importance in any manufacturing organization, yet it would appear, in practice, to be one of the most difficult things to achieve with accuracy.

This is due undoubtedly to such causes as errors in counting or measuring physical quantities, clerical mistakes, and unexplained losses in shops and stores, etc.

Assuming, however, that all possible precautions are taken within the organization to achieve accuracy and efficiency, the type of record card must be such as to provide information concerning the receipts and issues of materials, and the corresponding balance in stock. At the same time, it is essential to show clearly, the quantities yet to be delivered on outstanding orders. On many types of record cards in use, this is not readily apparent, especially when, as often happens, a supplier may commence delivery against one order before he has fulfilled all his commitments on a previous order. In Fig. 11, an arrangement of the receipts columns has been made, so that quantities received can be shown against separate orders.


STOCK RECORD
MATERIAL
UNIT
MAX STOCK LEVEL
MIN. STOCK LEVEL
ORDERING LEVEL
CURRENT PRICE PER UNIT
DATE
ORDERS.
ORDER NO.
QUANTITY
RECEIPTS
DATE
QUANTITY
TOTAL
DUE
DATE
QUANTITY
TOTAL
DUE
DATE
QUANTITY
TOTAL
DUE
DATE
QUANTITY
TOTAL
DUE
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DUE
DATE
QUANTITY
TOTAL
DUE
DATE
QUANTITY
TOTAL
DUE
DATE.
REQUISITION NO.
JOB NO.
QUANTITY
STOCK
STOCK +DUES

Fig. 11. The Stock Record Card

Similarly, although not indicated in Fig. 11, it may be desirable to record issues to the shops against various job numbers, with an " appropriation balance " column, so that a reliable guide is provided for the placing of new orders, by indicating for which jobs the stock plus receipts due will be appropriated, and the corresponding quantities.

It will also be observed in Fig. 11 that arrangements have been made for recording an adjusted price figure with each order. Opinions differ as to the best method of pricing materials when variations occur, and while in some cases it may suffice to work on the latest ruling price, this might react most unfavourably on the company in other instances.

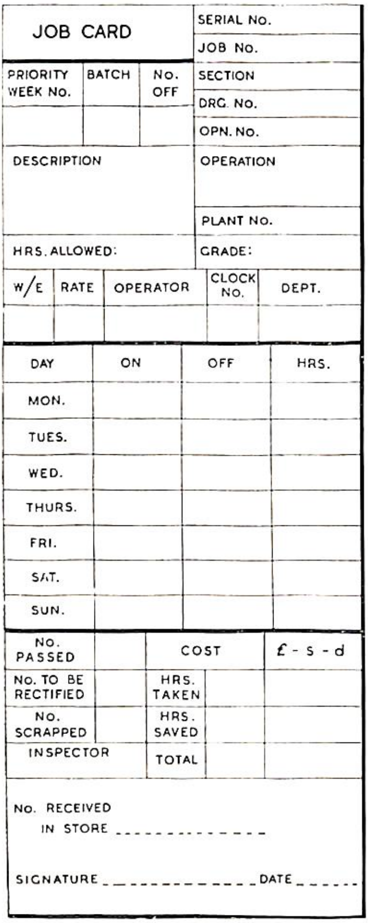
If, however, the stock records are maintained efficiently, there should be little difficulty in calculating the average price in the following manner :—

Assume that 100 feet of a certain class of bar material was purchased at 1/– per foot, but that after 60 feet have been issued for manufacturing purposes, a further order is placed on the supplier for 160 feet, the price in the meantime having risen to 1/3 per foot.

Immediately the first consignment of the second order is received, the current price is adjusted as follows :—

Stock	..	40 ft. at 1/– per ft.	=	40/–
On order	..	160 ft. at 1/3 ,, ,,	=	200/–
		Value of 200 ft.	=	240/–
		Average	=	1·2/– per ft.

It has been assumed, in the example that the 40 feet was still in stock, when the first consignment arrived against the second order. If, however, between the placing of the order and receipt of material commencing, further issues had taken place, the new stock figure at the time of actual receipt against the second order, would have been used in the calculation.



JOB CARD			SERIAL NO.
			JOB NO.
PRIORITY WEEK NO.	BATCH	NO. OFF	SECTION
			DRG. NO.
			OPN. NO.
DESCRIPTION			OPERATION
			PLANT NO.
HRS. ALLOWED:			GRADE:

W/E	RATE	OPERATOR	CLOCK NO.	DEPT.

DAY	ON	OFF	HRS.
MON.			
TUES.			
WED.			
THURS.			
FRI.			
SAT.			
SUN.			

NO. PASSED		COST		£ - s - d
NO. TO BE RECTIFIED		HRS. TAKEN		
NO. SCRAPPED		HRS. SAVED		
INSPECTOR		TOTAL		

NO. RECEIVED IN STORE _ _ _ _ _ _ _ _ _ _ _ _ _

SIGNATURE _ _ _ _ _ _ _ _ _ _ _ _ _ DATE _ _ _ _ _

Fig. 12. Job Card for Recording Time and Cost of Work

Finally, the layout of the card shown in Fig. 11 may be modified to suit particular cases depending upon the relative number of anticipated entries for receipts and issues respectively, and the back of the card can also be used in the interests of economy.

Job Card—Fig 12

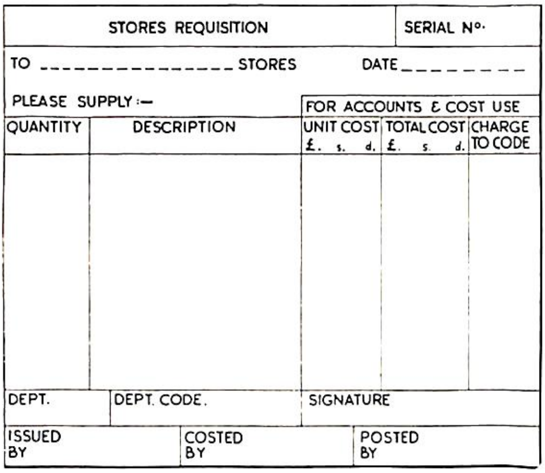
This is referred to here only because it is desired to point out the necessity for recording the time taken and cost for a certain amount of work to be accomplished. The actual form on which this time and cost is best recorded will be considered when production and cost control are discussed, and the system adopted may possibly necessitate alteration in the design of the job card. The type shown in Fig. 12 is suitable for use when the operators clock themselves on and off jobs, a system which is in common use. The card has a dual purpose in so far as it accompanies the completed work into the inspection departments, and thence into the finished parts stores.

When the manufactured parts are in stores, the card is duly signed and forwarded to the cost office, enabling costs to be recorded and bonus calculations made, so that the wages department can be notified as to amounts to be paid to the operatives.

Stores Requisition—Fig. 13

Whereas raw materials and finished parts for manufacturing operations should be drawn on appropriate requisitions, it is also important to control the issue of miscellaneous items of equipment which are consumable and which affect overhead costs, as distinct from direct material costs, on contracts in hand. Each department should have its code number, and the class of item required should also be coded so that costs can be posted under the correct heading.

The type of general requisition shown in Fig. 13 is suitable for this purpose, and could be used for obtaining from stores such items as cleaning rags, brushes, files, hammers, stationery, electric light bulbs, etc.



STORES REQUISITION SERIAL No.

TO _______________ STORES DATE _________

PLEASE SUPPLY:—

FOR ACCOUNTS & COST USE

QUANTITY	DESCRIPTION	UNIT COST £. s. d.	TOTAL COST £. s. d.	CHARGE TO CODE

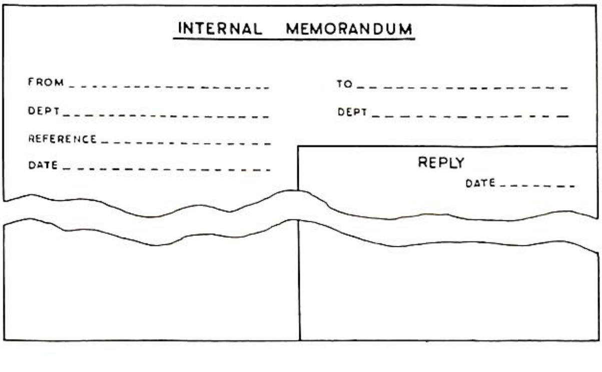
DEPT. DEPT. CODE. SIGNATURE

ISSUED BY COSTED BY POSTED BY

Fig. 13. Requisition Form for Obtaining Miscellaneous Consumable Equipment from Stores

Internal Memorandum—Fig. 14

Previous reference has been made to the unnecessary written communications which often pass between small sections of staff, and even between members of the same section of an office. If a certain item of information is required, and it is advisable to have it recorded, a " reply memorandum " of the type indicated in Fig. 14 is suggested. It is then unnecessary for the person replying to retain a copy, except in special circumstances, and when the matter is of sufficient importance to warrant it.



INTERNAL MEMORANDUM

FROM __________________ TO __________________

DEPT __________________ DEPT __________________

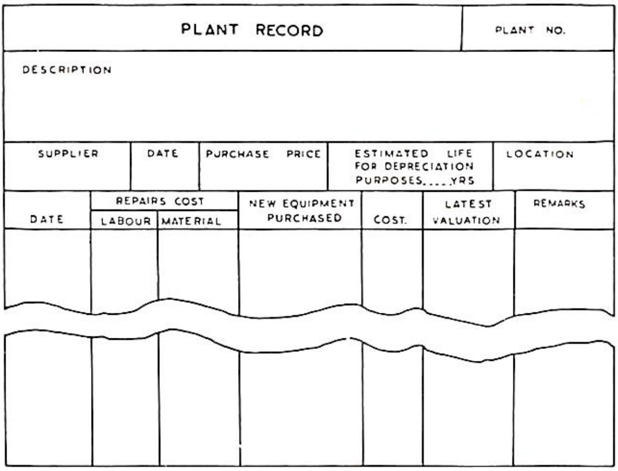
REFERENCE ______________

DATE __________________

REPLY

DATE _______

Fig. 14. Reply Memorandum Form for Internal Communications



PLANT RECORD					PLANT NO.	
DESCRIPTION						
SUPPLIER	DATE	PURCHASE PRICE	ESTIMATED LIFE FOR DEPRECIATION PURPOSES.....YRS	LOCATION		
DATE	REPAIRS COST LABOUR | MATERIAL	NEW EQUIPMENT PURCHASED	COST.	LATEST VALUATION	REMARKS	

Fig. 15. Plant Record Form Showing Repair Costs

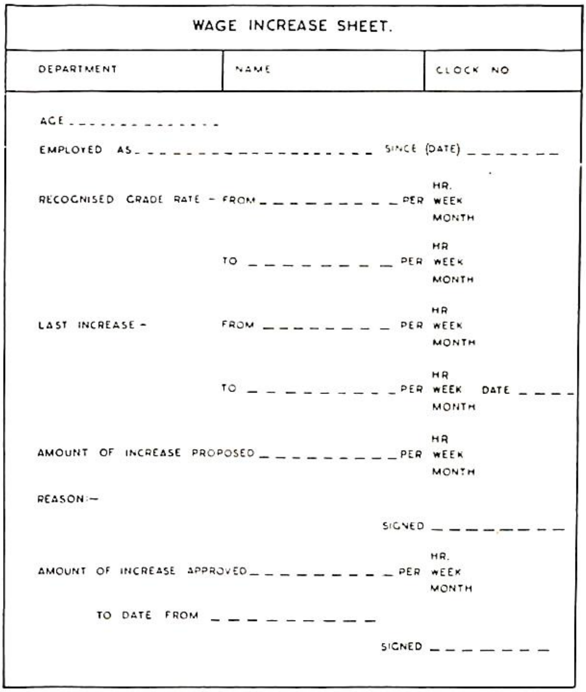
Plant Record—Fig. 15

Each item of plant involving capital expenditure should be suitably recorded, with sufficient data to enable the plant engineer to examine the periodic repair costs, and determine whether or not it would be more economical to purchase replacement machinery. At the same time, this record, as shown in Fig. 15, should be used for computing the valuation of plant, at the end of each financial year.

Wage Increase Sheet—Fig. 16

Whilst adhering to the principle that fixed ranges of wages should be agreed upon for each classification of work, especially amongst office staffs, it should, nevertheless, be a rule that all increases in pay are properly recorded and approved. A sample form is shown in Fig. 16, which should be suitably filed for reference in conjunction with the employee's record cards in the possession of the labour and wages departments.

The foregoing examples of paper-work do not, of course, cover anything like all that will be necessary in an organization, but have been chosen more or less at random, as examples to illustrate the variety that can be anticipated as being required At the same time it has been shown how necessary it is to design the various documents and record cards, etc., with due consideration as to how one section or department must work in with another. It is when separate departments begin to arrange for their own paper-work without the necessary consideration as to what is used elsewhere in the establishment, that efficiency declines and therefore earlier remarks to the effect that submission should be made to and approval given by a committee, should be borne in mind.



WAGE INCREASE SHEET.

DEPARTMENT	NAME	CLOCK NO

AGE ______________

EMPLOYED AS __________________ SINCE (DATE) _______

RECOGNISED GRADE RATE – FROM __________ PER HR. WEEK MONTH

TO _________ PER HR WEEK MONTH

LAST INCREASE – FROM _________ PER HR WEEK MONTH

TO _________ PER HR WEEK MONTH DATE ____

AMOUNT OF INCREASE PROPOSED __________ PER HR WEEK MONTH

REASON:—

SIGNED ________

AMOUNT OF INCREASE APPROVED __________ PER HR. WEEK MONTH

TO DATE FROM __________

SIGNED _______

Fig. 16. **Wage Increase Sheet for Employee**

CHAPTER 4

PREPARING FOR PRODUCTION

The degree of efficiency of the organization in manufacturing the required product or products in the stipulated time, in the correct balanced quantities of details and sub-assemblies, and at the appropriate prices, etc., depends entirely on the initial planning. Such planning must not be exclusively concerned with actual methods of manufacture, with an ever-open eye to decreasing the amount of money allowed to an operator in the shops for a certain job. Overhead expenses are just as important in determining the selling price, and in order to reduce the latter to a minimum, it must not be taken for granted that the wage packets of operatives producing the goods must also be as low as possible. This is a false idea discarded long ago by many reputable firms who have realised that initial planning of a job is the key to the situation.

Previous reference has been made to the modification of the design drawings to suit manufacturing methods as requested by the production departments. When this has been done, the first step is to prepare a parts list, which forms the basis for all sections of the organization, whether they are concerned with the actual manufacture or the necessary records for progressing and costing, etc.

The basic parts list should be compiled in the form of a " breakdown," corresponding to the breakdown of the component being manufactured, into assemblies, sub-assemblies and details, as shown in Fig. 17.

The form of presentation shown in Fig. 17 has been determined after experience with many schemes, and its salient points should be fully grasped so that its development for use, which will be explained later, can be fully appreciated.

In the example, it is supposed that a component C1 is composed of two major assemblies A1 and A2. Assembly A1 is made up of sub-assemblies SA1 and SA2, together with details D1, D2 and D3. One assembly A1 is used for each component C1, and the number of the details D1, D2, and D3 is shown as 1, 3, and 1 respectively.

Each sub-assembly SA1 is comprised of details :—

D4	..	2	off
D5	..	1	,,
D6	..	1	,,
D7	..	4	,,
D8	..	1	,,

It will be noticed however, that there are two of these sub-assemblies SA1 for each major assembly A1. In the same way details required for each sub-assembly SA2 are indicated, and there is one of these sub-assemblies to each major assembly A1.

COMPONENT — C1				DRG. NO.
ASSEMBLY NO	SUB-ASSY NO.	DETAIL NO.	NO OFF PER UNIT	
A1	—	—	1	
		D1	1	
		D2	3	
		D3	1	
	SA1	–	2	
		D4	2	
		D5	1	
		D6	1	
		D7	4	
		D8	1	
	SA2	—	1	
		D4	2	
		D5	1	
		D8	1	
		D9	4	
		D10	4	
A2	-	–	2	
		D1	1	
		D11	2	
		D12	2	
	SA1	–	1	
		D4	2	
		D5	1	
		D6	1	
		D7	4	
		D8	1	
	SA3	–	3	
		D14	2	
		D15	1	
		D16	3	

Fig. 17. Basic Parts List Showing Grouping of Details in Assemblies and Sub-Assemblies

It is also shown that there are two major assemblies A2 for each component C1, and each major assembly A2 calls for one sub-assembly SA1 and three sub-assemblies SA3. The number of details for each of these sub-assemblies is indicated.

It will be seen, therefore, that for each component C1 there will be required :—

1	off	major assembly	A1	
2	,,	,, ,,	A2	
4	,,	sub-assembly	SA1 (*a*)	
1	,,	,,	SA2	
3	,,	,,	SA3	
3	,,	detail	D1 (*b*)	
10	,,	,,	D4 (*c*)	
16	,,	,,	D7 (*d*)	
18	,,	,,	D16 (*e*)	etc., etc.

(*a*) two for assembly A1 and one for each of the assemblies A2.

(*b*) one for assembly A1 and one for each of the assemblies A2.

(*c*) two for each of the two sub-assemblies SA1 used in assembly A1 + two for the sub-assembly SA2 used in assembly A1, + two for each of the two sub-assemblies SA1 required for the two assemblies A2.

(*d*) four for each of the sub-assemblies SA1, of which there are two in assembly A1, and one in each of the two assemblies A2.

(*e*) three for each of the three sub-assemblies SA3 for each assembly A2.

This method of presenting the " breakdown " of a component to be manufactured in its constituent parts, is especially recommended as it can be used for the compilation of a record of rate-fixed times or prices allowed, material quantities and costs, the progress of jig and tool manufacture, etc., in the early days of a contract, and can assist in the estimating of price quotations for future anticipated orders.

This system may also suggest itself in certain cases for " spare parts " lists, complete with prices.

It is necessary to prepare, at the same time, a suitable index in which each part number is placed in numerical order, and against it are shown the page or pages of the " breakdown."

Material Summary

The ordering of material often has to be done before it is possible to make an accurate calculation of the quantities necessary. In such cases, past experience may influence the placing of initial bulk orders, which will be balanced against calculated final total requirements at a later stage of the contract.

It will, however, be necessary to order the requisite quantity of material, taking into account allowances for scrap, etc., and a summary must therefore be prepared, classified into specifications, sizes, diameters and gauges.

Planners are responsible for determining the sizes of material required according to the method of manufacture decided upon, and the design staff must indicate specification and gauge thickness, etc., where strength and weight factors are concerned.

The necessary information is co-related to the part numbers of the items to be manufactured, and a summary sheet of material required is prepared for forwarding to the purchasing department.

The following method was adopted very successfully by one company and showed a great saving in the time and clerical labour necessary for preparing the material summaries in connection with large numbers of different types of detail fittings manufactured from sheet material. This sheet material could be purchased in standard sizes such as: 6 ft. by 2 ft.; 6 ft. by 3 ft.; 6 ft. by 4 ft.; 8 ft. by 4 ft., and so on. For each size of sheet there were available various thicknesses such as 16 SWG., 18 SWG., 20 SWG., 22 SWG.

Each drawing, when received from the drawing office, indicated the specification and gauge of material and the planners added the size of sheet required.

The material summary clerks prepared their summaries by the use of ordinary sectional paper, without doing any calculations, as follows:—

A clerk had on his desk a series of sheets of sectional paper as shown in Fig. 18.

Each drawing gave the necessary information for rapidly determining the sheet material required for a component consisting of a number of details, and when looking at the drawings, the clerk would see:—

Drg. No.	*No. per Component.*	*Material.*
D1	2	Specn. A—9″ × 6″ × 18 G.
D2	4	,, B—2′·0″ × 1′·3″ × 20 G.
D3	1	,, A—3′·0″ × 2′·2″ × 18 G.
D4	12	,, A—3′·0″ × 3¼″ × 20 G.

The clerk was instructed not to fit parts together carefully as if doing a jig-saw puzzle, and quickly compiled a set of graphical sheets which summarised the quantity of material in gauges and sizes for a complete component. It was then a simple matter to calculate the order to be placed according to the number of components covered by the contract.

It was also possible at a later date to summarise information in such a form that the "cutting section" in the stores knew from what size sheet to cut the material for any detail, when the requisition was presented.

The sizes were not marked out accurately on the graph paper, but were sketched in free-hand; nevertheless, good results were obtained and less trouble was experienced towards the end of a contract, due to the stores cutting into say an 8 ft. × 4 ft. sheet when two 6 ft. × 2 ft. sheets would have sufficed, with a consequent shortage of the larger sheets later on.

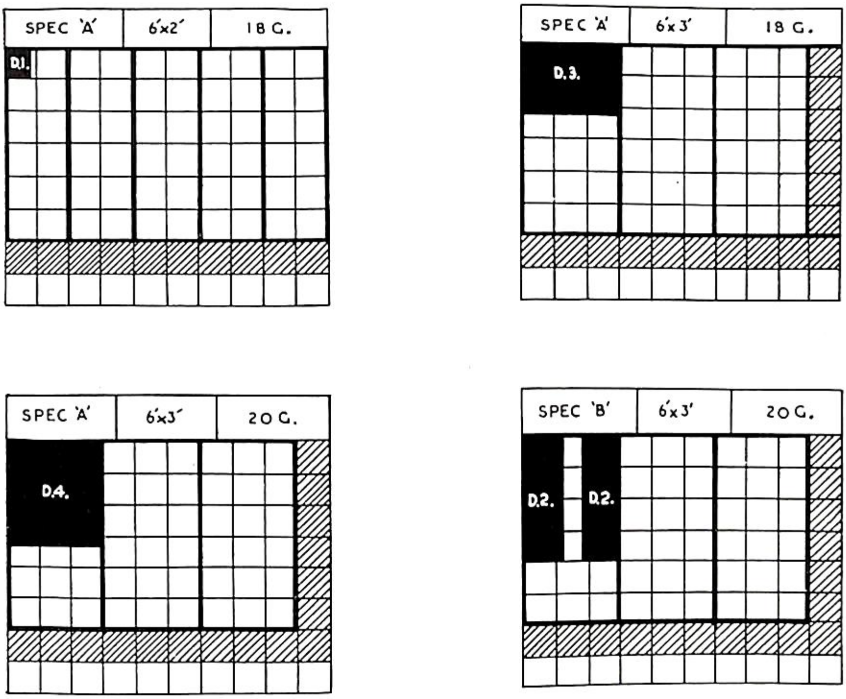


Fig. 18. Sectional Paper Sheets Used to Prepare Material Summaries

Planning for Manufacture

The method to be adopted for manufacturing the product is perhaps the most important factor of all, as ill-conceived ideas at the beginning may result in the whole productive unit of the organization being regarded as inefficient. Very often the shops are blamed at a later date, and foremen and workers alike subjected to complaints from the " higher-ups," simply because the planning departments were really at fault in the beginning. For this reason, it cannot be over-emphasized how important it is for the shop supervisors, and even individual workers at the bench, if necessary, to be brought into discussions regarding methods of manufacture.

It often happens that one can find a product being produced in a rather inefficient manner, solely because the original planning was not all that could be desired, and once production had started it would have meant a temporary stoppage in deliveries if alternative methods of manufacture had been introduced.

Obviously no specific details for planning methods of manufacture can be discussed here, as these depend on the particular type of product with which the executive and his factory are concerned. Nevertheless it is recommended as a general rule, that the major final assembly of the component should receive the first and most concentrated attention, leaving until later the actual methods of assembling sub-units, and the manufacture of the details.

Sometimes one may find planning staffs spending valuable time in the initial stages, deciding methods and designing tools for the manufacture of details, much of which is wasted, due to human errors and the accumulation of necessary tolerances which must be allowed in the shops. This results in trouble when the assembling of details commences, and parts will not mate together, or sub-assemblies will not fit into the final assembly jigs for the component.

Where a number of similar assembly jigs are necessary to give the required output of components, reference gauges are essential, so that at any time check tests can be made to find out whether distortion has occurred in any of the jigs. Another wise precaution is to fit a component made in the first jig, into the second and subsequent jigs, etc., before the latter are used for production. In addition, the first components from No. 2 and 3 jigs should be tried in jig No. 1 as a cross check, and so on. As the job proceeds, further attention can be paid to producing details from press tools, instead of by hand methods, and additional assemblies of sub-units, which will assist in increasing output and reducing cost.

Master templates should always be retained for detail parts, preferably made from the first set of details which was assembled together satisfactorily. Holes in jigs and templates for mating parts should be drilled in conjunction with or from the same master template. If they are separately marked out, more skilled operators' time is absorbed and even so the accuracy in " marking-out " may not be sufficient to ensure complete " mating " of the details.

In Chapter 2 reference was made to the probable advisability in certain cases of separating the drawing office into two sections, one exclusively concerned with the preparation of drawings to enable a prototype component to be made, and the other with the preparation of a set of production drawings. This suggestion is put forward because invariably the prototype article must be manufactured as quickly as possible in order to prove the " type " and therefore entirely different methods of production for the constituent parts will probably be used. For instance, small fittings will be hand-made instead of using press tools, or items will be manufactured from bar material instead of the castings which will later be employed for production quantities.

During recent times much progress has been made with what is known as lofting and layout reproduction, and systems based on the lithographic process lend themselves to the incorporation of the production draughtsmen into a full-scale layout department, which must of course be under the control of the chief production executive. Such a department eliminates the necessity for the preparation of many small scale drawings, and shapes can be drawn out to full size on the lofting tables and reproduced either on template materials or on the actual materials to be used in the manufacture of the parts, without having to be re-developed in the shops.

Careful consideration and tactful arrangements can often bring about a valuable saving of time by avoiding an inspection stage for checking layouts on the shop floor, if such a process as that mentioned above is introduced.

Shop Layout

Careful attention must be paid to the proposed location of the work in the shops. Work must " flow " from stage to stage and all unnecessary transport be eliminated. Having decided on the number of jigs and other details required, arrangements should be made to locate these jigs together with all necessary benches and bins adjacent for the accommodation of parts which are needed for incorporation at each particular stage. The importance of freedom of movement for the operators and suitable receptacles for the tools and equipment they require must not be overlooked.

Space requirements in the vicinity of jigs are often underestimated in the initial stages, with the result that when full production is under way, the shop floor is overcrowded and inefficiency results. It should be remembered that components must be removed from jigs when the assembly operations have been completed, and if benches must be shifted to enable this to be done, loss of time and money results.

If pneumatic or electric drills are to be used, unnecessary leads should not be allowed to trail all over the floor. It is much more economical in the long run to have the jigs " wired up " so that short leads can be " plugged-in " close to the working point.

Where benches are arranged in rows, as for instance in a detail manufacturing shop, it is advisable to have air-lines or electric cables neatly installed in parallel overhead, with short leads hanging down and suspension clips for retaining drills and riveting machines when not in use, so that they are not thrown down carelessly on to the bench or even on the floor.

Informing the Shops

In order that manufacture may begin, the shop foreman, chargehand, and individual operators concerned, require information concerning :—

(*a*) When the job should commence.
(*b*) Required completion date.
(*c*) Jigs and tools necessary.
(*d*) Material to be used.
(*e*) Operations to be performed.
(*f*) Time or price allowed.

Items (*a*) and (*b*) are linked up with the formulation of a programme, and machine and shop loading, and will be referred to later when dealing with production control.

The other information mentioned must be communicated by means of some form of " shop order," sometimes called a " works order " or " authority to manufacture." This shop order should indicate the type of machine on which the work is to be done at each successive operation, in the case of machine shop work, whilst for bench detail and assembly jobs, against each operation should be indicated the grade of labour, and any special jig or tool necessary.

The shop order should follow the job from its inception to final inspection, and appropriate remarks, entries and signatures should be recorded, so that when the finished parts are finally passed to stores the paper-work forming the order can be forwarded to the necessary progressing and costing departments as proof that certain work has been completed.

There is a tendency with many firms, to create and circulate much unnecessary paper-work in connection with shop orders and progress and cost records.

The writer suggests that all who desire efficiency with economy should thoroughly analyse suggested schemes before putting them into operation, and make investigations into the cost of clerical records as against their value in assisting towards economical production in the factory.

Obviously some means has to be devised for recording what is made, and at what price, but this should not necessarily be too closely tied up with the " shop order " paper-work, which is primarily intended to instruct the shops what to make and how to make it.

This last statement is based on the result of many years' experience, and if taken sufficiently seriously can lead to changes in many organizations with advantage.

The shop order then should be a paper or card, designed as simply as possible, to indicate what has to be made, with what materials, and by which methods, After passing with the work from operator to operator, it finally arrives at the stores with the finished articles. The order may consist of one form in " duplicate " or " triplicate, " so that the top copy can be torn off and retained say by the foreman, inspector or storekeeper, as the case may be, but great care should be taken to prevent a " book " of sheets being circulated unnecessarily.

CHAPTER 5

PRODUCTION CONTROL

In effect, the term " production control " covers, as the words imply, the control or supervision of all stages of the production organization, from the receipt of an order by the company to the closing of the commitments for a certain contract by the fulfilment of the delivery of the articles which it was undertaken to manufacture.

In many respects " production control " is interlocked with " cost control," but certain aspects which should be considered, are here discussed in two separate chapters.

Much has been written in text books—and many more volumes could be produced advantageously—dealing with both production control and cost control, but it is only intended here to deal briefly with some isolated items which it is felt might be of general interest, leaving the student to seek more detailed data elsewhere. This is because actual systems for production control and cost control must of necessity vary considerably according to the size of the factory and the type of product with which it is primarily concerned.

It is hoped that the following will be of interest and suggest ways and means for instituting efficient production control to the reader according to his specific requirements as he sees them.

It is assumed that the factory has received an order for a number of sub-assemblies and details which together form the whole.

It is also assumed that the order has been received on the understanding that these components shall be delivered, commencing at a certain time, at a certain rate, and at a certain selling price.

Preparation of Programmes

Estimates must be made first to decide when the various sub-assemblies and details will be required in order to meet the programme, from which it can be determined when the manufacture of details should commence, so that operations can be carried out economically.

In connection with details manufactured on presses or in a machine shop, due consideration must be given to the length of time required to " set up " the machine in relation to economic batch time. Very often a compromise has to be made because insufficient time or machine capacity is available to permit of producing a large number of details for one setting (which is naturally more economical), and the amount of compromise permissible must be considered very carefully.

After preliminary estimates have been made, the writer strongly recommends the adoption of graphical methods as the basis for formulating programmes for all the items required to make up the complete component. Graphical methods enable answers to be obtained quickly and give a more " pictorial view " than sheets filled with columns of figures. Specific programmes for quantities to be manufactured in various departments per week, or month, can always be prepared from the graphs when once they have been finalised.

The first step, therefore, is to prepare a graph showing the main essential requirements to meet the delivery programme, and it is suggested that this should be on the lines indicated in Fig. 19.

There will of course be a series of curves similar to those indicated, for each sub-assembly and its constituent details. At the commencement of the contract the cycle time between details and sub-assemblies

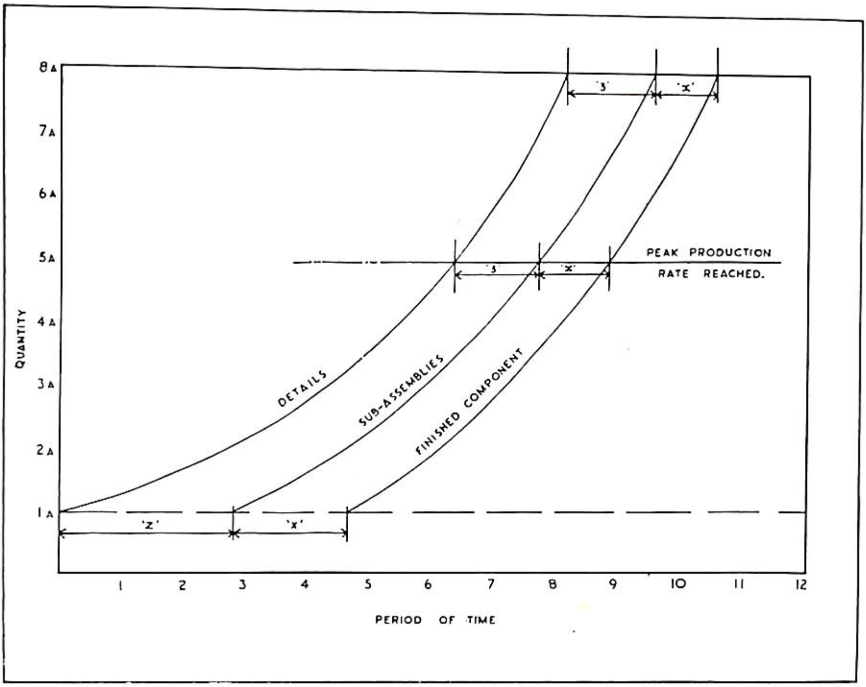


Fig. 19. Graph Showing Requirements to Meet Delivery Programme

and between sub-assemblies and the finished component, is greater than when the constant peak production rate has been reached. These cycle times are shown as " Z " and " X " and " z " and " x " respectively.

The rate at which various items are required at different periods of time throughout the contract can be read off from the curves. Particularly as regards details, the quantities needed must be considered in relation to the size of economic batches for manufacture, bearing in mind such factors as setting time and available capacity.

From a series of such graphs, therefore, can be determined the sequence in which the various items are required and a priority code established. This code, used in conjunction with the length of time calculated for the actual manufacture of a particular batch quantity, determines the time at which manufacture must commence in the shops.

A works schedule can then be prepared, indicating to the departments concerned the jobs which must be commenced in those departments on specific dates. A typical works schedule might be in the form shown in Fig. 20 and would be issued to each department. The same schedule might be used as a programme, since, by taking the particular week in which a job should start and adding on the cycle time for

DEPT. DETAIL–M

BATCH QUANTITIES TO BE COMMENCED IN WEEK SHOWN.

JOB. NO.	DRG. NO.	DESCRIPTION.	CYCLE TIME FOR MFTG. BATCH.	WEEK													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
W. 648	X.T.3159	DIAPHRAGM	4/7 WEEKS			50			50			50			50		

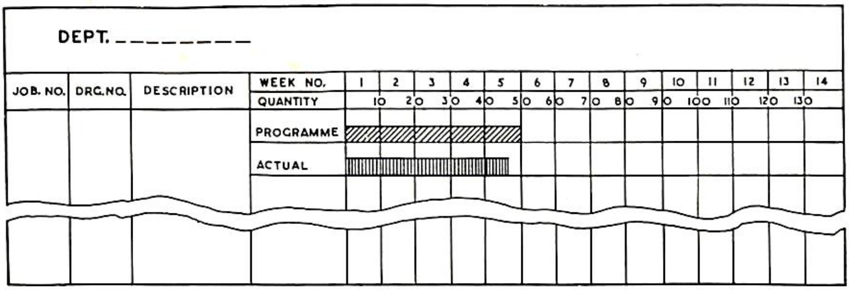
Fig. 20. Works Schedule Showing When Batches must be Commenced

manufacture, the completion date is obtained. In some instances, depending upon circumstances, it might be advantageous to prepare separate "programme of finished parts," especially where a large number of items are involved and the cycle times for manufacture vary considerably. It is then desirable to provide a chart, say in the foreman's office, from which he can see clearly the jobs that have to finish in the same week. Such programme sheets should have spaces wherein entries can be made of actual achievements.

Another good method of showing actual production against requirements is by a colour bar chart, as in Fig. 21.

There are, of course, many ways to convey to shop foremen the programme of work which is expected from their departments, and the form of presentation depends on the class of work, the duration of the manufacturing stages, and the frequency of movement of the product. The essential aim is to convey the necessary information in as simple a form as possible, with the added requirement that it must be possible to record the actual production on the programme sheet with the minimum of clerical work. When such a record has been entered, moreover, it should indicate pictorially the true position at a glance.

To give one more illustration, assume that a particular department is concerned with a series of assemblies which are to be manufactured in jigs, and that these assemblies are required at different times in

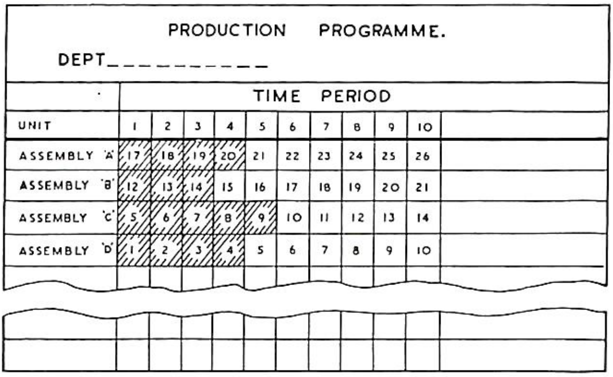


DEPT. _________

JOB. NO.	DRG. NO.	DESCRIPTION	WEEK NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
			QUANTITY	10	20	30	40	50	60	70	80	90	100	110	120	130	
			PROGRAMME	▨	▨	▨	▨	▨									
			ACTUAL	▥	▥	▥	▥	▥									

Fig. 21. Colour Bar Chart for Comparing Production with Requirements

larger jigs in which the final component is assembled. There may be a large number of these final assembly jigs so that a position may be reached where, for instance, the 20th main component jig requires its first assembly unit at about the same time as the first jig is ready for its fourth assembly unit, etc. A typical form of presentation for such a programme, for use by the foreman concerned with manufacturing the assembly units and supplying them to the foreman who is in charge of the assembly of the final components, would be as illustrated in Fig. 22. As each assembly unit is completed, it can be marked off, as shown, and the result is a pictorial representation which shows, at any time, items which are out of balance.



PRODUCTION PROGRAMME.

DEPT__________

	TIME PERIOD										
UNIT	1	2	3	4	5	6	7	8	9	10	
ASSEMBLY 'A'	▨ 17	▨ 18	▨ 19	▨ 20	21	22	23	24	25	26	
ASSEMBLY 'B'	▨ 12	▨ 13	▨ 14	15	16	17	18	19	20	21	
ASSEMBLY 'C'	▨ 5	▨ 6	▨ 7	▨ 8	▨ 9	10	11	12	13	14	
ASSEMBLY 'D'	▨ 1	▨ 2	▨ 3	▨ 4	5	6	7	8	9	10	

Fig. 22. Production Programme for Foreman in Charge of Final Assembly

It often happens, especially where departments are concerned with the manufacture of a large number of different details, that the presentation of a programme in chart form, as just illustrated, would be inadvisable. In these circumstances it is probably better to issue a card with the shop order. The filing of these cards in a cabinet can then be done in such a way, with the assistance of coloured adjustable tabs as to give a pictorial representation of the position as has been recommended in the previous paragraphs. The coloured tabs can be so attached that one colour represents all jobs which have to be commenced in a certain week, another colour all jobs which have to be finished in a certain week, a third colour, jobs which are behind schedule, and so on.

Whatever system is adopted, however, the programmes, and the subsequent progress records, showing the state of the production of parts, should be as simple as possible. It is not assumed that no further records are necessary in any organization, but it is suggested that executives should keep a watchful eye on the development of statistics in this connection. A position can easily be reached where the amount of paperwork and clerical staff involved is out of all proportion to the advantages gained. Basically, efficient and thorough planning from the start should obviate the necessity for undue clerical effort in following the production position. Too often the progress records in any case, are too late to enable corrective action to be taken. The object with all such records of manufacturing progress should be to notify the executive, *before* the event, of a probable deficiency in production, and not merely to present a statement after it has happened.

Shop and Machine Loading

Having taken all possible steps to arrange a production programme so that a continuous flow of details and sub-assemblies will be forthcoming at the proper rate to ensure the desired output of finished components, it is also essential to allocate the work correctly so that there is an even distribution and a continuous employment of the machines and man-power available.

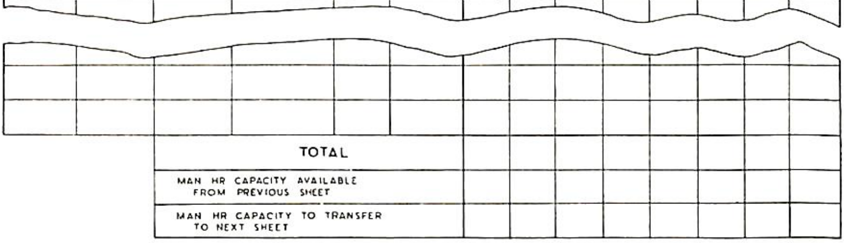
It is necessary, therefore, to tabulate the load of work which each particular job represents, say each week, and maintain a record comparing this with the available capacity either in man-hours or machine-hours, as the case may be.

If the records are in terms of, say, ratefixed hours, then of course the available capacity must be shown on the same basis, and this can probably best be done by making allowance for the average time saved in the particular sections of the shop concerned.

Fig. 23 shows a typical record sheet for tabulating the man-hours for batches of work, say in a bench detail department, and the information required can be taken directly from the planners' operation sheet on which the ratefixer has indicated the times allowed.

Having determined from the programme how much work has to be done each week, then from the total number of hours required, the number of operators of each grade can be ascertained. If it appears that the number of operators will vary week by week, and this is only to be expected in arriving at the first forecast, then slight adjustments can be made so that a constant number of operators can be employed usefully over as long a period as possible.

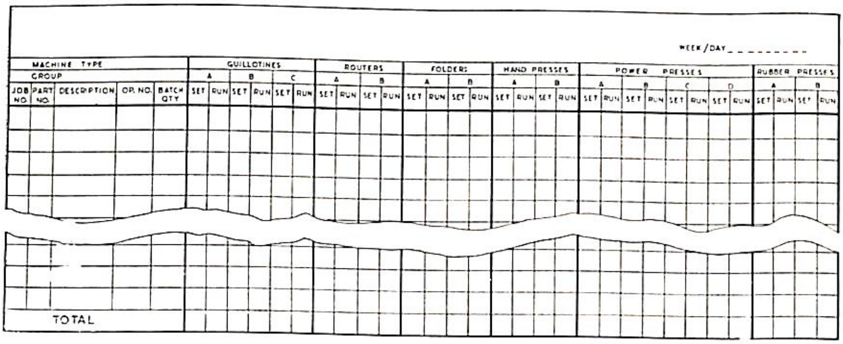
Two examples of machine loading sheets are shown in Fig. 24 and 26.



DEPT________ WEEK________ SHEET NO.

						LOAD IN MAN HOURS							
JOB NO	PART NO	ITEM NO	DESCRIPTION	OP NO	BATCH QUANTITY	GRADE I		GRADE II		GRADE III		GRADE IV	
						BATCH	CUM.	BATCH	CUM	BATCH	CUM.	BATCH	CUM.
	TOTAL												
	MAN HR CAPACITY AVAILABLE FROM PREVIOUS SHEET												
	MAN HR CAPACITY TO TRANSFER TO NEXT SHEET												

Fig. 23. Record Sheet for Tabulating Man-hours for Batches of Work



WEEK/DAY_ _ _ _ _ _ _ _

MACHINE TYPE					GUILLOTINES						ROUTERS				FOLDERS				HAND PRESSES				POWER PRESSES								RUBBER PRESSES			
GROUP					A		B		C		A		B		A		B		A		B		A		B		C		D		A		B	
JOB NO.	PART NO.	DESCRIPTION	OP. NO.	BATCH QTY	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN	SET	RUN
TOTAL																																		

Fig. 24. Sheet Used for Recording Daily or Weekly Loads on Machines in a Press Shop

Fig. 24 illustrates the form of sheet that might be used for presenting the daily or weekly loads on the various types of machines in a press shop. The different kinds of machines are grouped according to their capacities, and generally this is quite sufficient as it is seldom worth while to attempt to load each particular machine individually.

In the machine shop it is usual that the number of operations required to produce a part is much greater than for press-work, and the material, after being issued from stores, passes from stage to stage over a fairly lengthy period of time before it becomes a finished part. The operations to be performed and the times which these operations will occupy have, therefore, to be carefully analysed, taking into account also the time necessary for movement and inspection.

It is, therefore, essential to make a time-cycle study, and a suitable method of doing this is shown in Fig. 25. The illustration indicates that a batch of 200 parts will take 4 weeks to manufacture so that, in order that these parts may be available 23 weeks before the final component is required, as shown by the priority, it will be necessary to commence manufacture of the batch at least 27 weeks before the final component date.

When dealing with a large number of different parts, the planners must watch carefully to ensure that the different types of machines in the machine shop are constantly and economically employed, and may have to alter the batch quantities for different operations. For instance, in dealing with the 200 batch quantity just referred to, the planner may find that due to insufficient capacity on the vertical milling machines, when considered in conjunction with other jobs, he may have to split the batch into two of 100 each.

The weekly load on the various types of machines such as centre-lathes, and capstans, can be easily summarised on a form as shown in Fig. 26, and here again the total loads must be compared with the available capacity, as previously mentioned.

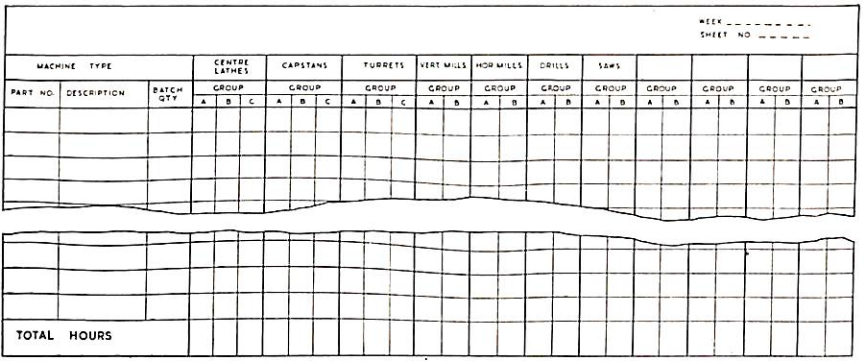
PART NO. D4	ITEM NO. 2	ISSUE NO. 3	PRIORITY 23 WEEKS.
DESCRIPTION JOINT PLATE	NO. PER COMPONENT 4	BATCH QUANTITY 200	TIME CYCLE FOR BATCH 4 WEEKS.

OP. NO.	ROUTE		SETTING TIME (HRS)	TIME PER PIECE (MINS)	TIME PER BATCH (HRS)	WAITING & MOVEMENT TIME (HRS)	TOTAL TIME ALLOWED (HRS)	PROGRESSIVE TOTAL TIME (HRS)	CYCLE WEEKS (50 HR WEEK)
	STAGE	M/C GROUP							
	STORES					10	10	10	1
1	HOR. MILL	B	½	6	20	8	28	38	1
2	HOR. MILL.	A	½	3	10		10	48	1
3	BENCH			12	40	8	48	96	2
4	VER. MILL.	A	¼	3	10	8	18	114	3
5	INSPECT					20	20	134	3
6	HOR MILL	B	½	3	10	4	14	148	3
7	DRILL	B		1½	5	8	13	161	4
8	INSPECT					10	10	171	4
9	HEAT TREAT					15	15	186	4
10	INSPECT					10	10	196	4
11									
12									

Fig. 25. Time Cycle Study for a Component

When a new contract is commencing, the load of work, both as regards machines and manpower, will probably gradually increase until a steady level of production is reached and maintained. In order to watch this carefully and to know what capacity may be available for other work (and this particularly applies towards the end of a contract when the load begins to fall off), it is recommended that the graphical system be adopted to show the load of work against capacity, as this gives a clear picture and is most useful in estimating conditions at a later period.

Some indication of the types of records with which the planning department is concerned have now been given. When all the necessary information has been made available, the appropriate department will issue the orders to the shops according to the programmes set.

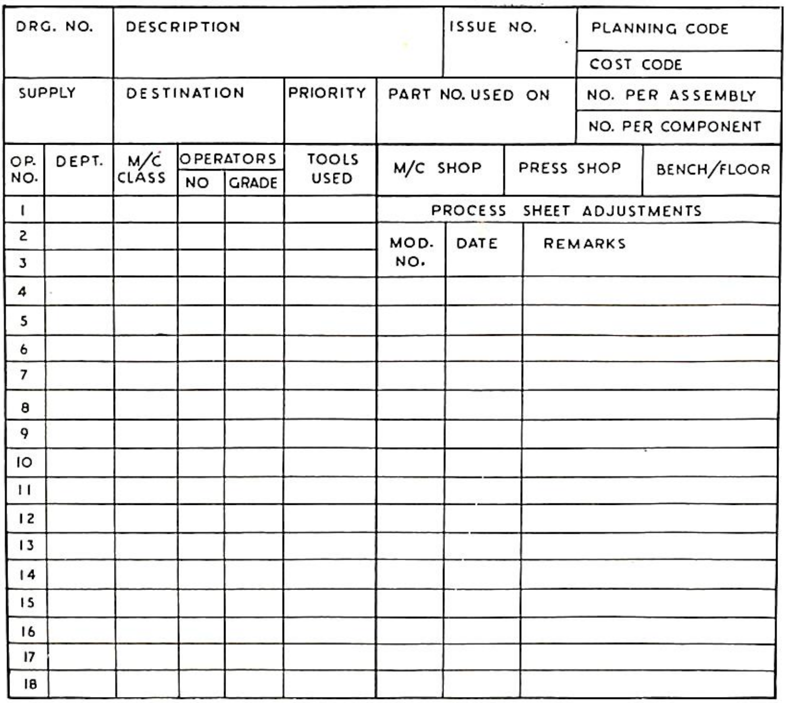


WEEK ....
SHEET NO ......

MACHINE TYPE			CENTRE LATHES			CAPSTANS			TURRETS			VERT MILLS		HOR MILLS		DRILLS		SAWS									
PART NO.	DESCRIPTION	BATCH QTY	GROUP			GROUP			GROUP			GROUP		GROUP		GROUP		GROUP		GROUP		GROUP		GROUP		GROUP	
			A	B	C	A	B	C	A	B	C	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
TOTAL HOURS																											

Fig. 26. Machine Shop Weekly Loading Sheet

It often happens, however, that a planning office tends to be somewhat inefficient due to inadequate measures having been taken to summarise, concisely, the work which has been done in the department, so that queries can be dealt with quickly and continuity of orders on the shops maintained when repeat contracts are received.



DRG. NO.	DESCRIPTION				ISSUE NO.	PLANNING CODE COST CODE	
SUPPLY	DESTINATION		PRIORITY	PART NO. USED ON		NO. PER ASSEMBLY NO. PER COMPONENT	

OP. NO.	DEPT.	M/C CLASS	OPERATORS NO	OPERATORS GRADE	TOOLS USED	M/C SHOP	PRESS SHOP	BENCH/FLOOR
1						PROCESS SHEET ADJUSTMENTS		
2						MOD. NO.	DATE	REMARKS
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								

Fig. 27. Typical Filing Card for Works Schedule or Similar Record

						PRODUCTION			SPARES		
WORK SCHDLE. NO.	ISS. NO.	DATE	WEEK OF MANUFCTRE.	NO OF UNITS ORDERED		ORDERS AVAILABLE		BALANCE REQD.	ORDERS AVAILABLE		BALANCE REQD.
				PROD.	SPRS.	QTY.	ORDER NO.	UNITS	QTY.	ORDER NO.	UNITS

Fig. 27A. Reverse Side of Card in Fig. 27

Loading sheets, time-cycle studies, programmes and work schedules, should be carefully filed and a good index system established so that the necessary documents can be found quickly. For this purpose a card index system is to be recommended and if the cards are filed in Part No. series, for instance, then all the relevant data to identify the part with the other documents should be indicated.

The type of card will, of course, vary with individual requirements, but an example, which proved its worth in one particular instance, is illustrated in Fig. 27. On the back of the card (Fig. 27A) a record was

MACHINE TYPE	GROUP	MACHINES AVAILABLE & OPERATORS REQD. IF FULLY MANNED		OPERATORS ON PAYROLL & EQUIVALENT MACHINE CAPACITY		OPERATORS PRESENT & EQUIVALENT MACHINE CAPACITY		TOTAL M/C HOURS AVAILABLE AT "X" EACH	WAITING TIME, ETC.	SETTING TIME	TOTAL PRODUCTIVE HOURS INC. SETTING	PRODUCTIVE M/C UTILISATION	
		NO. OF M/CS	NO. OF OPS.	NO. OF OPS.	NO. OF M/CS	NO. OF OPS.	NO. OF M/CS					HRS.	%
TOTALS													

Fig. 28. Machine Utilization Record Form

maintained of the contracts, so that at any time the one card gave all the necessary information concerning the operations to be performed, tools required, departments concerned, works orders issued and balance of contracts.

Utilisation Data

Having taken steps to load both machines and labour in the shops correctly, it is also desirable to have periodic returns to show the actual utilisation of machines and labour which has been accomplished. In general, these returns should be prepared weekly, and their usefulness is greatly reduced if they are not published within a few days of the ending of the period in question.

It might happen that one particular department was failing to meet the programme, and utilisation records, as suggested, might indicate, for instance, that an excessive amount of waiting time was being booked. to a certain group of machines. This might be due to the recurrence of some mechanical breakdown, and therefore it is wise to show each week a separate tabulated statement analysing the total waiting time under various headings and giving the causes. Fig. 28 illustrates a typical form for machine utilization records, whilst Fig. 29 shows a method of presenting the data concerning labour utilization.

The information conveyed by these two utilization records is fairly comprehensive and can be used not only in assisting production control, but also by the welfare department, especially if absenteeism is excessive and the reasons need investigation.

DEPT OR SECTION	GRADE OF LABOUR	NO. OF OPERATORS								TOTAL ATTENDANCE HOURS	ANALYSIS OF OPERATORS & ATTENDANCE HOURS											
		ON PAYROLL					ATTENDED	ABSENT SICK	ABSENT OTHER CAUSES		MALE						FEMALE					
		DAY		NIGHT		TOTAL					DAY			NIGHT			DAY			NIGHT		
		M.	F	M	F.						NO OF OPS	HOURS CLOCKED	AV. PER OP.	NO OF OPS.	HOURS CLOCKED	AV PER OP.	NO OF OPS	HOURS CLOCKED	AV PER OP	NO OF OPS.	HOURS CLOCKED	AV. PER OP.
TOTALS																						

Fig. 29. Labour Utilization Record Form

CHAPTER 6

COST CONTROL

It is important to understand the meaning of cost control, particularly with regard to its function in assisting production control. Careful consideration must first be given to determine exactly how far, in any particular organization, it is deemed necessary that cost control shall go, taking into account the amount of work involved and the resultant overhead charges, in relation to the value of the results obtained in maintaining the complete factory organization as an efficient productive unit. Frequently a desire to improve cost control has only resulted in a large increase in the number of documents used and the staff required to handle them. The overall increase in costs involved in obtaining answers thought to be necessary has been uneconomical, and it would have been more efficient to have paid attention to the actual method of cost recording rather than to have accumulated data in greater detail.

The functions of cost control may be defined briefly as follows :—

1.—To make sure that the production cost of an article, including materials and overhead charges, with the necessary margin for a reasonable profit, does not exceed the selling price.

2.—To provide a means whereby, at regular intervals throughout the duration of a contract, the expenditure can be watched in case the cost is tending to exceed that which the contract allows.

3.—To enable data to be accumulated which will assist in the preparation of estimates when quoting for future work.

There are, of course, other costs to be considered, such as administrative and departmental staff and material costs, and heating, lighting and various other items which have to be carried as on-costs in the establishment. In general, the recording of these latter items does not give rise to any complicated system. It is usually found that it is in connection with the actual production costs that systems can so easily become somewhat involved.

For this reason, therefore, it is intended to deal mainly with direct production costs, even down to individual detail items to be manufactured, leaving it to the executive concerned to decide exactly how much detailed information he actually requires in his own organization to balance efficiency against economy.

Overall Labour Expenditure

Assuming that a contract has been received for a certain number of components at a fixed price, the manager's first concern is to know at what rate he should be spending money if each constituent part to be manufactured is being made for the right price and to programme. It may be that the contract is for 1,000 components, and that the price allowed falls gradually for batches of 50, until, commencing with the 300th component, it is constant. Knowing this, the total contract price can be arrived at easily, and by deducting the amounts for profit, overheads, and materials, the amount which can be allowed for direct labour wages can be deduced.

The date when delivery of components must begin and the rate required will give the manager an approximate idea as to how the weekly expenditure may be expected to build up, so that an estimated curve can be drawn. Having done this, by simple integration a total expenditure curve can be plotted. A few preliminary " try-outs " will enable two curves to be obtained which should be fairly reliable and serve as a guide against which the progress of the contract can be observed.

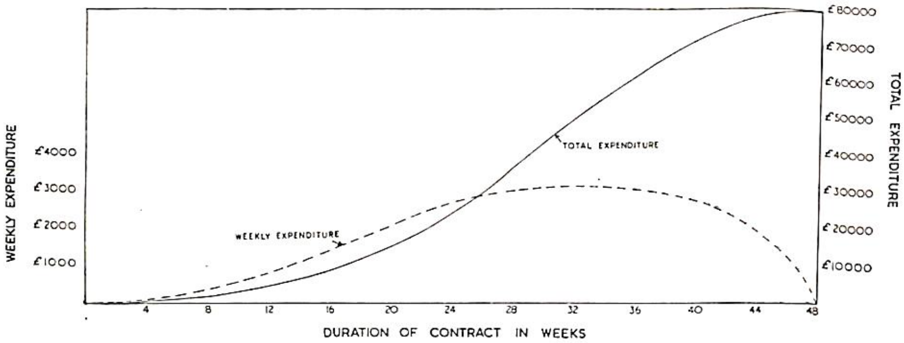


Fig. 30. Labour Expenditure Curves for Contract

Fig. 30 shows a typical set of labour expenditure curves for a contract involving a total expenditure of approximately £80,000 extending over a period of 48 weeks from the commencement of manufacture.

The curve of weekly expenditure is useful also in approximating the number of operatives to be employed, knowing the average weekly wage of each.

If a component is made up of a number of assemblies and sub-assemblies which will be manufactured in different departments in the factory, a similar set of curves can be prepared for each department and for each particular unit of the component. The labour price which can be allowed for each unit must, of course, be communicated to the methods or planning department. so that they can decide on methods of manufacture and types of jigging to be adopted.

Build-up of Costs for a Component

During the planning of a job if separate units of the component have to be produced for certain prices, as laid down by the manager, it is necessary to build up a statement showing a unit in its constituent parts and the corresponding prices, so that eventually a complete break-down of costs results. In this connection the method of preparing the break-down of a component as shown in Chapter 4 (Fig. 17) may be extremely useful, for against each drawing number can be shown a unit price for both labour and material. An easy method is thus afforded of showing total costs of sub-assemblies and assemblies.

COMPONENT:- C.1		DRAWING No:-		PRICE PER UNIT						
ASSEMBLY No.	SUB-ASSEMBLY No.	DETAIL No.	No. OFF PER UNIT	LABOUR			MATERIAL			
				£.	S.	D.	£.	S.	D.	
A.1	–	–	1	1.	2.	0		5.	0	
		D.1	1			4			6	
		D.2	3			3			4	
		D.3 'A'	1			2			5	'A'
				1.	3.	3		6.	11	(1)
	SA.1	–	2		3.	6		1.	6	
		D.4	2			4			2	
		D.5	1			6			3	
		D.6	1			9		1.	0	
		D.7	4		1.	1			7	
	'B'	D.8	1			10			9	'B'
					10.	7		6.	2	(2)
	'C'			1.	1.	2		7.	4	'C' (3)
	SA.2	–	1		2.	0		4.	0	
		D.4	2			4			2	
		D.5	1			6			3	
		D.8	1			10			9	
		D.9	4			2			4	
	'D'	D.10	4		1.	1		1.	3	'D'
'E'					9.	0		11.	8	'E' (4)
				2.	13.	5	1.	10.	11	(5)

Fig. 31. Breakdown of Costs of Assemblies and Sub-Assemblies

Using the same items as in Fig. 17 it will be assumed that the individual labour and material prices of the details are as follows :—

		Prices per each			
		Labour		*Material*	
		s.	d.	s.	d.
Detail	D1		4		6
,,	D2		3		4
,,	D3		2		5
,,	D4		4		2
,,	D5		6		3
,,	D6		9	1	0
,,	D7	1	1		7
,,	D8		10		9
,,	D9		2		4
,,	D10	1	1	1	3

It is also assumed that each sub-assembly SA1 comprising details D4, D5, D6, D7 and D8 costs 3/6 to assemble and that the additional material required, including nuts and bolts, costs 1/6. In the same way sub-assembly SA2 has a labour price of 2/- and an additional material cost of 4/-.

If the putting together of sub-assemblies SA1 (2 off) and SA2 (1 off) to form assembly A1 costs £1 2s. for labour and 5/- for material, a complete cost breakdown for assembly A1 can be prepared, as shown in Fig. 31.

Taking sub-assembly SA1, its complete labour price is made up as follows :—

		s.	d.
2 off detail D4 at	4d. each		8
1 ,, ,, D5 ,,	6d. ,,		6
1 ,, ,, D6 ,,	9d. ,,		9
4 ,, ,, D7 ,,	1s. 1d. ,,	4	4
1 , ,, D8 ,,	10d. ,,		10
Assembly of these details to form unit SA1		3	6
	Total	10	7

Similarly the material cost for one sub-assembly SA1 is 6s. 2d. These totals (2) are shown immediately beneath the line " BB," and as there are two of these sub-assemblies in each assembly A1, an additional line " CC " has been drawn with the double totals underneath it (3).

There is thus shown in Fig. 31, not only the price for each of the details but also the cost of each unit SA1.

In the same way, the cost of the sub-assembly SA2 is found by locating that number in the sub-assembly column and running down the column until a horizontal line meets it ("DD"). Immediately beneath this line is found the price for each complete unit SA2 (4).

Also, the price of a complete assembly A1 is found after locating the number in the assembly column and running down the column until a horizontal line meets it (" EE "), The required price is shown immediately beneath this line (5). The labour price for this assembly is made up of :—

	£	s.	d.
1 off assembly SA2 at 9s. 0d. each		9	0
2 ,, ,, SA1 ,, 10s. 7d. ,,	1	1	2
Details D1, D2, D3, and final assembly cost	1	3	3
Total ..	£2	13	5

This system of presenting a cost breakdown can be extremely useful, particularly to the quotations department when preparing prices for spare parts.

Where the costs under this system of presentation result in the formation of a book, it is a simple matter to prepare an index of all drawing numbers in numerical order, and against each to record the page or pages in the book where the drawing number occurs.

Cost Recording

The costs actually required to be known, and the means adopted to obtain them, cannot be considered in general terms, since much depends upon the type of product and the quantities being produced. As mentioned previously, the executive must weigh efficiency with economy in his particular organization.

It is, however, essential to have some means of reconciling the wages paid to operatives with the labour expenditure to be charged against the items being manufactured, either individually or in bulk, such as against different job numbers or contracts.

Two methods of doing this will now be described, one involving an estimate (rate-fixed time) to which a periodic correction factor is applied, and the other based on direct booking of time taken by an operator or group of operators on a particular job. In each case the costing of details will be considered. The method can be adapted for groups of details or sectional costs of a component, by simply reducing the quantity of paper work involved, and charging costs to a bulk number instead of to individual detail numbers, when it is considered satisfactory to do so.

1. *Indirect Method.*—With this system, each section of the works, either by departments or sub-departments, is carefully graded so that the operatives employed therein are all as nearly as possible paid the same hourly rate. The average hourly rate for the section is calculated periodically, say every month or three months, depending upon labour fluctuations.

All jobs are carefully planned and rate-fixed on a time basis, so that when an operator receives a job he knows that he is allowed a certain number of hours in which to complete it.

Operators are not booked on or off jobs, but their hours of attendance are recorded from clock cards, and the bonuses they are paid depend upon the number of finished jobs which have been passed by the inspection department.

Thus, if the working week commences on a Monday morning and by Friday evening an operator has finished 5 jobs for which he is allowed 15 hours each, then he is entitled to 75 hours pay. If for the week ending Saturday mid-day, the operator had attended 55 hours, then the cost records would show 55 hours basic pay + 20 hours bonus for that week. Obviously a part of the sixth job would have been done on Saturday morning, but this would be included in the next week when, assuming the same rate of working, he would have six completed jobs credited to him.

Now if the calculated average rate for the section in which this operator worked was 15·23d. per hour, then the recorded standard labour cost of the job referred to would be :—

$15 \times 15{\cdot}23$ pence each

Should the basic rate of the operator in question be 1/2½d. per hour, then a separate cost ledger would show that for the week in question there was a minus value, or credit to the actual costs, of :—

$5 \times 15 \times 0{\cdot}73$ pence

In the same way another operator might be doing jobs in the same section with a basic rate of 1/4d. per hour, and in this case the number of jobs which he had passed by the inspection department would result in a plus or debit adjustment to the costs.

This system for some classes of work is very efficient and simple to operate and particularly lends itself to mechanical aids, where punched cards are used. The cards can be in different colours to represent batch quantities or departments and can be punched to indicate such information as job number, drawing number, operation number, and rate-fixed hours allowed.

2. *Direct Method.*—As an alternative to the previous system, there is what may be termed the "direct" costing procedure which involves the recording of the actual times taken and costs for any particular job or group of jobs.

This system can, of course, be used to a varying degree to obtain the actual costs of individual details or operations, or simply to charge costs in bulk to a specific works order number. The manager must, as already mentioned, decide to what extent he is prepared to develop the system, depending upon his requirements.

It is important at the outset, to establish a suitable cost code system, and this can be such as to assist production records also.

If a component " A " can be sub-divided into four main assemblies, they can be coded as A1, A2, A3 and A4 respectively. Each main assembly can be made up of a number of sub-assemblies, such as :—

A1/1, A1/2, A1/3, etc.
A2/1, A2/2, A2/3, etc.
A3/1, A3/2, A3/3, etc.
and so on.

Details can be coded, say, in three sections, to cover for instance :—

Machine Shop details - *a*
Press Shop details - *b*
Bench details - *c*

Hence any press shop details for sub-assembly A2/3, would be coded as :—

A2/3/b

If it is considered preferable, the use of letters can be avoided, and numerals only used.

A typical example would be :—

5/2/3/2

where, taken in sequence, the code would mean :—

5 - Component No.
2 - A main assembly of component 5.
3 - A sub-assembly of main assembly 5/2.
2 - A detail manufactured in the press shop, and used on sub-assembly 5/2/3.

If a number of different components were to be manufactured under a single order or contract, and if each individual detail or drawing number were coded and given a section number as explained above, the cost sheets could be collected together in any way to suit requirements.

For instance, if only the total all-in cost of component No. 5 were required, all sheets commencing with the figure 5 would be totalled. If the cost of machine shop details as a group for a range of components in one particular order were required, then this would be the summary of all sheets 1/- -/- -/1, 2/- -/- -/- -/1, 3/- -/- -/1, etc.

Each individual cost, of course, can in addition be obtained by recording time taken against a specific drawing number, or even against separate operation numbers if necessary.

The sequence of operations to record costs is shown diagramatically in Fig. 32 and can be explained briefly as follows :—

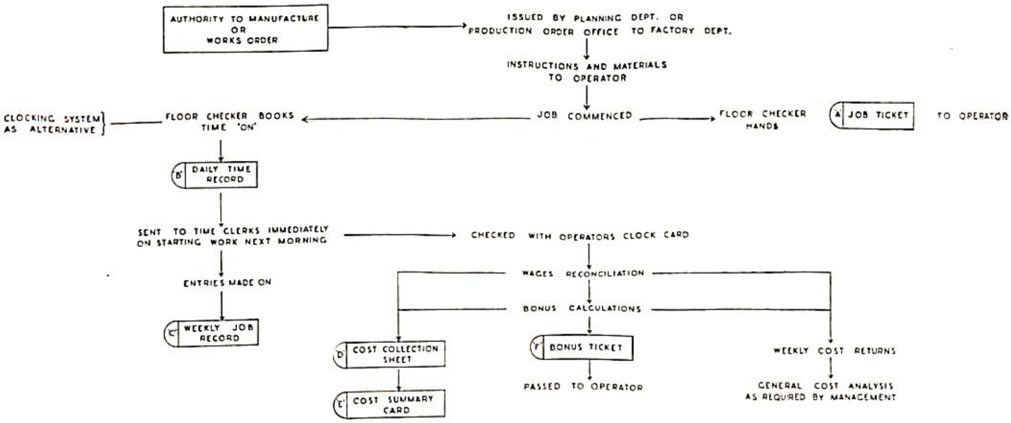

AUTHORITY TO MANUFACTURE OR WORKS ORDER
ISSUED BY PLANNING DEPT. OR PRODUCTION ORDER OFFICE TO FACTORY DEPT.
INSTRUCTIONS AND MATERIALS TO OPERATOR
CLOCKING SYSTEM AS ALTERNATIVE
FLOOR CHECKER BOOKS TIME 'ON'
JOB COMMENCED
FLOOR CHECKER HANDS
'A' JOB TICKET
TO OPERATOR
'B' DAILY TIME RECORD
SENT TO TIME CLERKS IMMEDIATELY ON STARTING WORK NEXT MORNING
CHECKED WITH OPERATORS CLOCK CARD
ENTRIES MADE ON
WAGES RECONCILIATION
BONUS CALCULATIONS
'C' WEEKLY JOB RECORD
'D' COST COLLECTION SHEET
'F' BONUS TICKET
WEEKLY COST RETURNS
'E' COST SUMMARY CARD
PASSED TO OPERATOR
GENERAL COST ANALYSIS AS REQUIRED BY MANAGEMENT

Fig. 32. Diagram Showing Costing Procedure Routine

Instructions to commence work are issued by a " works order " or " authority to manufacture." This document not only ties up the operations to be performed, material and tools to be used, and time allowed, but supplies the code which is to be used for booking operatives' times. A " cost collection " sheet is issued simultaneously and similarly coded.

Through the normal shop supervision channels of foremen or charge-hands, the operator is told to start on a job, and the floor checker records the time of starting, handing a " job ticket " to the man, which he retains and which informs him of the starting time recorded.

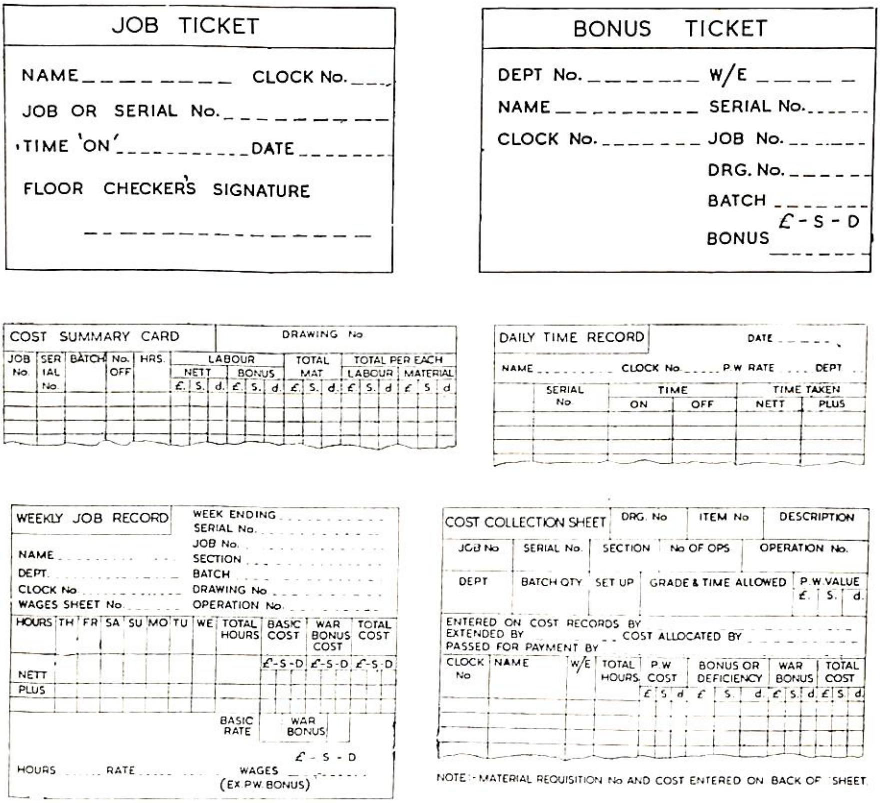
The Floor Checker is also responsible for entering this time on the " daily time record " for that operative.

If the job cannot go unchecked because the operative is held up temporarily, perhaps due to a material shortage or alteration, a new " job ticket " is made out for " waiting time," and the same procedure is followed when the job is restarted.

Operators can be booked " off " jobs in exactly the same way, or as is sometimes found feasible, the time of booking " on " the second job may be deemed the time of finishing the first job. It is important in systems of this sort, for the floor checkers to be fully conversant with the type of work for which they are booking times, and to be able to identify the various jobs which the operatives are doing. Otherwise there are loop-holes for anyone dishonest to have his times booked on one job while actually executing another. This leads to the corrupt practice of obtaining excessive piece-work bonus earnings on some jobs, but allowing other jobs to go into debt, and such cases have been known to occur in practice.

Sometimes the floor checker is replaced by a clock recorder whereby the operator clocks himself " on " and " off " each job.

The various forms required for the operation of the system outlined in Fig. 32 are shown in Fig. 33.



JOB TICKET

NAME __________ CLOCK No. ____

JOB OR SERIAL No. __________

TIME 'ON' __________ DATE ________

FLOOR CHECKER'S SIGNATURE

____

BONUS TICKET

DEPT No. ________ W/E ______

NAME __________ SERIAL No. ______

CLOCK No. ________ JOB No. ______

DRG. No. ______

BATCH ______

BONUS £ - S - D ______

COST SUMMARY CARD					DRAWING No														
JOB No.	SERIAL No.	BATCH	No. OFF	HRS.	LABOUR						TOTAL MAT			TOTAL PER EACH					
					NETT			BONUS						LABOUR			MATERIAL		
					£.	S.	d.	£.	S.	d.	£.	S.	d.	£	S.	d	£	S	d

DAILY TIME RECORD DATE ______

NAME ________ CLOCK No. ______ P.W RATE ...... DEPT ...

	SERIAL No.	TIME		TIME TAKEN	
		ON	OFF	NETT	PLUS

WEEKLY JOB RECORD

WEEK ENDING ....

SERIAL No. ....

JOB No. ....

NAME .... SECTION ....

DEPT. .... BATCH ....

CLOCK No .... DRAWING No ....

WAGES SHEET No. .... OPERATION No. ....

HOURS	TH	FR	SA	SU	MO	TU	WE	TOTAL HOURS	BASIC COST	WAR BONUS COST	TOTAL COST
									£-S-D	£-S-D	£-S-D
NETT											
PLUS											

BASIC RATE WAR BONUS

HOURS .... RATE .... WAGES (EX PW BONUS) £ - S - D ....

COST COLLECTION SHEET	DRG. No	ITEM No	DESCRIPTION	
JOB No	SERIAL No.	SECTION	No OF OPS	OPERATION No.
DEPT	BATCH QTY	SET UP	GRADE & TIME ALLOWED	P.W. VALUE £. S. d.

ENTERED ON COST RECORDS BY

EXTENDED BY __ COST ALLOCATED BY ________

PASSED FOR PAYMENT BY

CLOCK No	NAME	W/E	TOTAL HOURS	P.W COST			BONUS OR DEFICIENCY			WAR BONUS			TOTAL COST		
				£	S	d	£	S.	d.	£	S.	d.	£	S.	d.

NOTE :- MATERIAL REQUISITION No AND COST ENTERED ON BACK OF SHEET.

Fig. 33. Job and Bonus Tickets, Cost Summary Card, Daily Time and Weekly Job Records and Cost Collection Sheet

Ratefixing and Costing

Costing systems such as those just described are often looked upon by the production side of an organization as something which for some reason or other, must be tolerated, and it is not always easy to obtain the co-operation from the shops which is essential. An operative at the bench, if he stops to think, should readily appreciate that the article he is manufacturing cannot be sold at a loss to the company for very long without he himself being personally affected, possibly to the extent of being unemployed. Therefore it will be apparent that a costing system of some sort must be instituted in order to serve as a means, either of arriving at the selling price of an article, or determining whether, in the case of a previously fixed selling price, the actual cost has resulted in a profit or loss.

Particularly in cases such as the latter, ratefixing of operations in the shops plays an important part, and such ratefixing should be most carefully handled by competent personnel in order to avoid disputes with the workers which are all too prevalent in many industries.

As mentioned previously, a wise management will always bear in mind the relative costs of :—

(*a*) Direct labour
(*b*) Material
(*c*) On-costs or overheads
(*d*) Profit

and it is not necessarily the rule that in order to reduce the total cost, the operative making the article in the shops should receive the full force of the " cut." Efficient ratefixing can only be accomplished after much study and experience of the operations to be performed, and should aim at giving the operatives a square deal. Loose ratefixing is just as inefficient and troublesome as that whereby the operative simply cannot earn a reasonable bonus and therefore allows the job to run into debt.

Ratefixing is frequently done on a time basis whereby an operator is allowed so many hours for a certain job. This system is often troublesome and leads to much additional work in the costing system, especially when the rates of pay of operatives vary in the shops. It is, after all, only reasonable to expect a man who has, perhaps, been awarded an extra 1d. per hour efficiency money above the basic rate, to perform his work in quicker time than another who has not received such an increase. Therefore, in adopting a ratefixing system, careful thought should be given to one where a stipulated sum of money is given for a certain amount of work.

Briefly, it is advisable that a " price " for a job be set rather that a " time " for a job. With the former system, costs of jobs can be recorded automatically from the ratefixer's price, and the only variation to be watched for is when a " debt " job is recorded by the staff who calculate the bonus payments to be made to the operatives.

Ratefixing in the past has given rise to far too many labour disputes, and much of what has happened can be avoided in the future if managements will do more to obtain the confidence of the workers by letting them see that they believe in fair and reasonable prices, which will be assessed by competent planning and ratefixing staffs.

Overhead Charges

The confidence and co-operation of the workers, referred to previously, can hardly be expected if they see obvious signs of inefficiency in the staff departments and wasteful expenditure which helps to increase unnecessarily the overhead charges.

The efficient manager will, therefore, closely watch the costs in connection with :—

Administration, sales and service.
Secretarial, accounting and costing.
Planning and production control.
Design staffs.
Maintenance of buildings.
Heating, lighting, power.
Telephone charges, stationery and other material costs.
Travelling and other miscellaneous expenses.

These and sundry other items must be watched, and carefully prepared budgets should be presented to departmental heads for comparison with the actual periodical returns supplied by the accountants. The manager should be very concerned with any upward trend and call for an immediate detailed examination rather than wait for a period of several months to elapse, after which it may be too late to effect a remedy.

Charts and graphical presentation of overhead costs in sections should be maintained in exactly the same way as suggested for production control. If a company is operating at 100 per cent. overheads. these costs are equal to the productive labour costs and are therefore deserving of equal attention.

The efficient manager realises this and acts accordingly.

CHAPTER 7

SOME NOTES ON TOP MANAGEMENT

The chief executive of a company should always keep before him an overall picture of the whole organization, and various charts in his office should constantly present to him the essential information which he requires to know, but without any unnecessarily detailed data.

To this end the following suggestions are put forward :—

1.—Suitably mounted on the table and made to harmonize with the other office furniture, there should be a scale model of the factory site, with all its buildings and pathways. The model should also embrace a suitable portion of the surrounding district, and by distinctive colouring, for example, the factory site and buildings with which the manager is directly concerned should be shown clearly.

2.—A plan drawing of the main factory premises should show the position of the assembly units for instance, and be arranged so that coloured discs can be moved to various positions, say, daily, to indicate the main movements of the manufactured items. It should be the duty of a progress clerk every morning to show the movement position correctly up to the previous evening.

3.—An enclosed chart cabinet should be arranged so that separate charts can be withdrawn easily in tray fashion. The charts should give such information as :—

(*a*) The numerical strength of manufacturing and staff departments, suitably graded.

(*b*) Overhead costs, sectionalised as required, and easily comparable with budget figures.

(*c*) Up-to-date output figure of main products compared with delivery promises.

(*d*) The labour and material expenditure on various contracts compared with estimates.

4.—Models and actual specimens of a few special products of the firm may be suitably arranged in a case or cases.

5.—Framed photographs can be provided which, at a glance, give a brief historical record of the factory and its products.

There are, too, other factors which may assist the manager in the essential task of creating a correct impression on visitors, especially if they happen to be potential customers. His office should be large enough not to appear over-crowded with the necessary furniture, but to give an air of spaciousness. It is necessary for the manager tactfully to impress his visitors with his business-like efficiency, his over-all knowledge of what is going on, and his kindly control of those whom he employees. He should not attempt to convince visitors of the immense detailed knowledge he has at his command, but should adopt the principle of calling into discussions the various departmental chiefs who should be more capable of directly answering questions asked.

Points such as the method of addressing departmental chiefs, especially in the presence of visitors or junior officials, are not so trivial as may be supposed. For a manager to ask a man or boy in the shops as to the whereabouts of the foreman " X " instead of " Mr. X " is not only bad taste, but does much to destroy the desired atmosphere of respect in any workshop or office. In the same way a departmental chief should not admonish a section leader in the hearing or presence of others, particularly the junior staff. This " discipline through respect " must commence at the top and permeate all departments throughout the whole " family-tree." If it is absent the efficiency of the organization is adversely affected, for the manager does not obtain the maximum possible spirit of co-operation and team work, which is essential.

Regulations and Information concerning the Factory

It may be beneficial to prepare a small booklet for presentation to each employee, when he or she commences work with the company. Such a booklet need not be elaborate or costly and might contain the following :—

(*a*) A personal message from the manager, couched in such terms as to make the new employee feel that he or she is being welcomed to become a part of the organization, and inviting co-operation with regard to the general cleanliness of the factory or office, responsibility for tools and equipment, and participation in the various social activities.

(*b*) A brief description of the company's organization and activities and the factory layout.

(*c*) A summary of the various departments within the organization together with the names and recognised titles of the departmental heads.

(*d*) A brief description of how the organization works, with particular reference to shop order paper-work, clock cards, material requisitions and time recording, with which the majority of employees in the shops are concerned.

(*e*) Information on tool store's cards, and the system in operation for the supply of certain standard equipment to operatives.

(*f*) Details of hours of work, meal breaks, holidays and sickness arrangements.

(*g*) Information on smoking regulations in various shops and offices.

(*h*) Particulars of facilities for the supply of hot water, tea, milk, and even chocolate. Examples could be quoted where efficiently organized arrangements have been made for selling refreshments of this nature to employees during working hours, without impairing production efficiency.

(*j*) Notes on arrangements whereby employees can be communicated with from home in cases of emergency. In this connection arrangements can often be made with the G.P.O. to erect in some convenient place on the factory site, a public telephone kiosk. This is recommended as it eliminates the necessity for setting up a procedure whereby an employee might have to obtain permission to make a private telephone call while he is at work, and the book-keeping involved for making charges.

(*k*) The names and addresses of trade union representatives.

(*l*) Particulars of health and welfare facilities provided.

(*m*) Notes on sport and educational facilities. In the field of sport much can be done to encourage inter-departmental competitions, while on the technical side, it is well worth providing a library of relevant text books and periodicals to encourage everyone to keep themselves up-to-date with the latest information concerning the particular industry in which they are engaged.

(*n*) Details of canteen facilities. It is recommended that a canteen committee be formed representing the workers, staff, and management, and that every endeavour be made to maintain a good class restaurant standard. If this is done there should be no difficulty in enforcing a rule that workers do not use the canteen whilst wearing greasy overalls, and obtaining the co-operation of all concerned in maintaining a high standard of general cleanliness.

Apprenticeship Schemes

Many firms have derived benefit from introducing a good apprenticeship scheme. Some form of competitive examination for lads of school-leaving age may be held annually, and after the required number have been selected, arrangements can be made, in conjunction with local education authorities, to provide for practical and theoretical training to a high standard. The apprentices should be systematically transferred from department to department and records kept of their progress.

Suggestion Schemes

Throughout any factory organization there can always be found employees who, although not occupying important positions, nevertheless have, from time to time, useful ideas and suggestions, or even constructive criticism to bring forward, if they are encouraged to do so. This can be done by instituting a simple " suggestion scheme " whereby in various positions in offices or work-shops, suggestion boxes are located in which written suggestions can be placed. The boxes should be opened at regular intervals. Suggestion forms can be distributed from time to time especially to invite suggestions on particular subjects, and these forms should be numbered so that the employee concerned can retain a counterfoil slip bearing the same number, and thus not disclose his identity until after the suggestion has been considered. Further interest can be created by forming small committees to deal with various subjects, members of these committees representing all grades of employees and management. A suggestion which is adopted should be suitably rewarded, the serial number being posted on a notice board so that the originator, who holds the counterfoil, can be traced.

Conclusions

The efficiency and success of a company, while dependent to a large extent on the management, is also determined by the capability of everyone employed to do his or her particular job. A good manager, therefore, must not only be efficient himself but also be the co-ordinating pivot of the factory organization in all its phases, along the lines indicated.

The author does not claim to have dealt with any particular aspect in sufficient detail, but has merely referred to typical items in support of the statement made in the opening paragraphs, that " management is a science " and calls for the necessary education if a reasonable degree of success is to be achieved.

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